

# Lab2P2

January 15, 2024

```
[1]: from osgeo import ogr
```

```
[2]: r = ogr.Geometry(ogr.wkbLinearRing)
r.AddPoint(1,1)
r.AddPoint(5,1)
r.AddPoint(5,5)
r.AddPoint(1,5)
r.AddPoint(1,1)
poly = ogr.Geometry(ogr.wkbPolygon)
poly.AddGeometry(r)
print(poly.ExportToWkt())
```

POLYGON ((1 1 0,5 1 0,5 5 0,1 5 0,1 1 0))

```
[3]: geojson = """{"type": "Polygon", "coordinates":
    ↳ [[[1,1], [5,1], [5,5], [1,5], [1,1]]]}"""
polygon = ogr.CreateGeometryFromJson(geojson)
print(polygon)
```

POLYGON ((1 1,5 1,5 5,1 5,1 1))

```
[4]: # 1 create area

print("The area of our polygon is %d" %polygon.Area())
```

The area of our polygon is 16

```
[5]: cen = polygon.Centroid()
print(cen)
```

POINT (3 3)

```
[6]: # 4 convex hull does the same in this case as boundary, as our polygon is a
    ↳ square:

ch = polygon.ConvexHull()
print(ch)
```

```
POLYGON ((1 1,1 5,5 5,5 1,1 1))
```

```
[7]: # 5 buffer. A buffer value of 0 (zero) returns the same values as boundary and  
      ↪ convex hull in this example:
```

```
buffer = polygon.Buffer(0)  
print(buffer)
```

```
POLYGON ((1 1,1 5,5 5,5 1,1 1))
```

```
[8]: #6 check if a point is inside our polygon
```

```
point = ogr.Geometry(ogr.wkbPoint)  
point.AddPoint(10,10)  
polygon.Contains(point)
```

```
[8]: False
```

```
[9]: import osgeo.ogr, osgeo.osr
```

```
[10]: #1 set the spatial reference
```

```
spatialReference = osgeo.osr.SpatialReference()  
spatialReference.ImportFromProj4('+proj=longlat +ells=WGS84+datum=WGS +no_defs')
```

```
#2 create a new shapefile
```

```
driver = osgeo.ogr.GetDriverByName('ESRI Shapefile')  
shapeData = driver.CreateDataSource('my_polygon.shp')
```

```
#3 create the layer
```

```
layer = shapeData.CreateLayer('polygon_layer',spatialReference, osgeo.ogr.  
    ↪wkbPolygon)  
layerDefinition = layer.GetLayerDefn()
```

```
#4 geometry is put inside feature
```

```
featureIndex = 0  
feature = osgeo.ogr.Feature(layerDefinition)  
feature.SetGeometry(polygon)  
feature.SetFID(featureIndex)
```

```
#5 feature is put into layer
```

```
layer.CreateFeature(feature)
```

```
#6 check if the file has been created correctly
```

```
!ogrinfo my_polygon.shp
```

```
INFO: Open of `my_polygon.shp'  
      using driver `ESRI Shapefile' successful.
```

1: my\_polygon (Polygon)

```
[11]: # import modules
from osgeo import ogr
import os

#reference the shapefile and specify driver type
shapefile = r>Data/10m_cultural/ne_10m_populated_places.shp"
driver = ogr.GetDriverByName("ESRI Shapefile")

#open the data source with driver, zero means open in read-only mode
dataSource = driver.Open(shapefile, 0)

#use the GetLayer() function for referencing the layer that holds the data
layer = dataSource.GetLayer()

#pass in the coordinates for the data frame to the SetSpatialFilterRect()
→function. This filter creates a rectangular extent and selects the features
→inside the extent

layer.SetSpatialFilterRect(-102, 26, -94, 36)
for feature in layer:
    # select only the cities inside of the USA
    # we can do this through a SQL query:
    # we skip the cities inside of the USA,
    # and print the names of the cities that are
    if feature.GetField("ADMONAME") != "United States of America":
        continue
    else:
        print(feature.GetField("NAME"))
```

Ardmore  
McAlester  
Bryan  
San Marcos  
Longview  
McAllen  
Harlingen  
Alice  
New Braunfels  
Cleburne  
Brownwood  
Big Spring  
Vernon  
Childress  
Texas City  
Pasadena  
Baytown

Arlington  
Texarkana  
Fort Smith  
Lawton  
Norman  
Muskogee  
Shawnee  
Conroe  
Nacogdoches  
Eagle Pass  
Edinburg  
Kingsville  
Huntsville  
Killeen  
Lufkin  
Del Rio  
San Angelo  
Sherman  
Beaumont  
Bay City  
Port Lavaca  
Falfurrias  
Beeville  
Dumas  
Denton  
Temple  
Galveston  
Freeport  
Victoria  
Wichita Falls  
Waco  
Lubbock  
Abilene  
Tyler  
Ft. Worth  
Corpus Christi  
Austin  
Amarillo  
Laredo  
Oklahoma City  
San Antonio  
Dallas  
Houston

```
[12]: from shapely.geometry import Polygon  
p1 = Polygon(((1, 2), (5, 3), (5, 7), (1, 9), (1, 2)))  
p2 = Polygon(((6,6), (7,6), (10,4), (11,8), (6,6)))
```

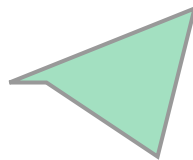
```
p1
```

[12]:



```
[13]: # A new command line is required for printing the second polygon:  
p2
```

[13]:



```
[14]: # Point takes tuples as well as positional coordinate values
```

```
from shapely.geometry import Point  
point = Point(2.0, 2.0)  
q = Point((2.0, 2.0))  
q
```

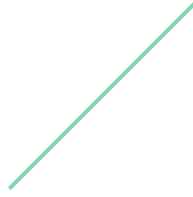
[14]:



```
[15]: # line geometry
```

```
from shapely.geometry import LineString  
line = LineString([(0, 0), (10,10)])  
line
```

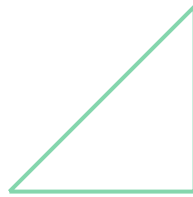
[15]:



```
[16]: # linear rings

from shapely.geometry.polygon import LinearRing
ring = LinearRing([(0,0), (3,3), (3,0)])
ring
```

[16]:



```
[17]: # collection of points

from shapely.geometry import MultiPoint
points = MultiPoint([(0.0, 0.0), (3.0, 3.0)])
points
```

[17]:



```
[18]: # collection of lines

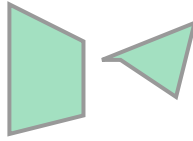
from shapely.geometry import MultiLineString
coords = [((0, 0), (1, 1)), ((-1, 0), (1, 0))]
coords
```

[18]: [((0, 0), (1, 1)), ((-1, 0), (1, 0))]

```
[19]: # collection of polygons

from shapely.geometry import MultiPolygon
polygons = MultiPolygon([p1, p2,])
polygons
```

[19]:



```
[20]: print(p1.area)
print(p1.bounds)
print(p1.length)
print(p1.geom_type)
```

```
22.0
(1.0, 2.0, 5.0, 9.0)
19.59524158061724
Polygon
```

```
[21]: import json
from shapely.geometry import mapping, shape
p = shape(json.loads('{ "type": "Polygon", "coordinates": [[[1,1], [1,3 ],[3,3]]]}'))
print(json.dumps(mapping(p)))
p.area
```

```
{ "type": "Polygon", "coordinates": [[[1.0, 1.0], [1.0, 3.0], [3.0, 3.0], [1.0, 1.0]]]}
```

[21]: 2.0

```
[22]: import fiona
c = fiona.open(r"Data/110m_cultural/ne_110m_admin_1_states_provinces.shp")
rec = next(iter(c))
rec.keys()
```

```
[22]: dict_keys(['type', 'id', 'properties', 'geometry'])
```

```
[23]: import pprint
pprint.pprint(rec['type'])
pprint.pprint(rec['id'])
pprint.pprint(rec['properties'])
```

```
pprint.pprint(rec['geometry'])
```

```
'Feature'
```

```
'0'
```

```
OrderedDict([('featurecla', 'Admin-1 scale rank'),
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```



```

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```

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'type': 'Polygon'}
```

```
[24]: print(len(c)) # prints total amount of features
      print(c.driver) # prints driver name
      print(c.crs) # prints coordinate reference system of data file
```

```
51
ESRI Shapefile
{'init': 'epsg:4326'}
```

```
[25]: import pprint, fiona
      with fiona.open\
        (r"Data/110m_cultural/ne_110m_admin_1_states_provinces.shp") as src:
        pprint.pprint(src[0])
```

```
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[26]: from shapely.geometry import shape
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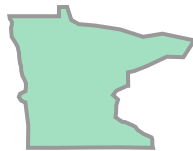


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```

```
[27]: geom = shape(minnesota)
      geom
```

[27]:



```
[28]: import geopandas as gpd

      %matplotlib inline
```

```
df = gpd.read_file\
(r>Data/110m_cultural/ne_110m_admin_1_states_provinces.shp")
df
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```
[28]:
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7	California	CA Calif.
8	Colorado	CO Colo.
9	Nevada	NV Nev.
10	New Mexico	NM N.M.
11	Oregon	OR Ore.
12	Utah	UT
13	Wyoming	WY Wyo.
14	Arkansas	AR Ark.
15	Iowa	IA Iowa
16	Kansas	KS Kans.
17	Missouri	MO
18	Nebraska	NE Nebr.
19	Oklahoma	OK Okla.
20	South Dakota	SD S.D.
21	Louisiana	LA
22	Texas	TX Tex.
23	Connecticut	CT Conn.
24	Massachusetts	Commonwealth of Massachusetts MA Mass.
25	New Hampshire	NH N.H.
26	Rhode Island	State of Rhode Island and Providence Plantatio...
27	Vermont	VT
28	Alabama	AL Ala.
29	Florida	FL Fla.

30	Georgia	GA Ga.
31	Mississippi	MS Miss.
32	South Carolina	SC S.C.
33	Illinois	IL Ill.
34	Indiana	IN Ind.
35	Kentucky	Commonwealth of Kentucky KY
36	North Carolina	NC N.C.
37	Ohio	OH Ohio
38	Tennessee	TN Tenn.
39	Virginia	VA
40	Wisconsin	WI Wis.
41	West Virginia	WV W.Va.
42	Delaware	DE Del.
43	District of Columbia	DC D.C.
44	Maryland	MD
45	New Jersey	NJ N.J.
46	New York	NY N.Y.
47	Pennsylvania	Commonwealth of Pennsylvania PA
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49	Michigan	MI Mich.
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1	None	None	POLYGON ((-116.04823 49.00037, -113.05950 49.0...
2	None	None	POLYGON ((-97.22894 49.00089, -97.21414 48.902...
3	None	None	MULTIPOLYGON (((-155.93665 19.05939, -155.9080...
4	None	None	POLYGON ((-116.04823 49.00037, -115.96780 47.9...
5	None	None	POLYGON ((-117.03143 48.99931, -117.02665 47.7...
6	None	None	POLYGON ((-109.04522 36.99991, -109.04367 31.3...
7	None	None	POLYGON ((-114.64222 35.05311, -114.62212 34.9...
8	None	None	POLYGON ((-102.05017 40.00081, -102.04012 38.4...
9	None	None	POLYGON ((-117.02825 42.00002, -114.03422 41.9...
10	None	None	POLYGON ((-109.04367 31.34190, -109.04522 36.9...
11	None	None	POLYGON ((-116.91500 45.99998, -116.67900 45.8...
12	None	None	POLYGON ((-114.03422 41.99312, -111.05024 42.0...
13	None	None	POLYGON ((-111.08518 44.50615, -111.06719 44.5...
14	None	None	POLYGON ((-89.66292 36.02307, -89.67351 35.940...
15	None	None	POLYGON ((-96.45266 43.50179, -95.35994 43.500...
16	None	None	POLYGON ((-102.04118 36.99198, -102.04012 38.4...
17	None	None	POLYGON ((-89.66292 36.02307, -90.31539 36.023...

18	None	None	POLYGON ((-102.05017 40.00081, -102.05017 40.0...
19	None	None	POLYGON ((-103.00322 36.99516, -102.04118 36.9...
20	None	None	POLYGON ((-96.53945 46.01797, -96.55689 45.872...
21	None	None	POLYGON ((-94.05976 33.01212, -93.09403 33.010...
22	None	None	POLYGON ((-106.50734 31.75429, -106.61953 31.9...
23	None	None	POLYGON ((-73.49794 42.05451, -72.73222 42.035...
24	None	None	POLYGON ((-71.80091 42.01325, -72.73222 42.035...
25	None	None	POLYGON ((-70.81505 42.86519, -70.93360 42.884...
26	None	None	POLYGON ((-71.85383 41.32004, -71.79295 41.466...
27	None	None	POLYGON ((-72.45707 42.72708, -73.28203 42.743...
28	None	None	POLYGON ((-88.16696 34.99967, -86.90968 34.999...
29	None	None	POLYGON ((-87.53039 30.27420, -87.45789 30.411...
30	None	None	POLYGON ((-85.00519 30.99069, -85.05442 31.108...
31	None	None	POLYGON ((-91.15624 33.01000, -91.10808 33.206...
32	None	None	POLYGON ((-80.86501 32.03316, -81.03644 32.084...
33	None	None	POLYGON ((-91.43033 40.36860, -91.41023 40.551...
34	None	None	POLYGON ((-88.05108 37.81960, -88.01881 38.021...
35	None	None	POLYGON ((-89.49836 36.50620, -89.27398 36.611...
36	None	None	POLYGON ((-83.07637 34.97903, -84.32097 34.986...
37	None	None	POLYGON ((-84.82368 39.10653, -84.81787 39.799...
38	None	None	POLYGON ((-90.24924 35.02083, -90.13493 35.113...
39	None	None	MULTIPOLYGON (((-83.33059 36.67266, -83.17851 ...
40	None	None	POLYGON ((-91.22820 43.50125, -91.25466 43.613...
41	None	None	POLYGON ((-81.97254 37.53595, -82.16728 37.554...
42	None	None	POLYGON ((-75.04839 38.44876, -75.71462 38.449...
43	None	None	POLYGON ((-77.04124 38.78954, -77.04123 38.789...
44	None	None	POLYGON ((-75.37754 38.01538, -75.37754 38.015...
45	None	None	POLYGON ((-75.52781 39.49865, -75.55427 39.691...
46	None	None	POLYGON ((-73.49794 42.05451, -73.55349 41.289...
47	None	None	POLYGON ((-80.51893 40.64111, -80.51627 42.324...
48	None	None	POLYGON ((-70.64573 43.09008, -70.75102 43.080...
49	None	None	POLYGON ((-89.95766 47.28691, -89.84283 47.464...
50	None	None	MULTIPOLYGON (((-153.22873 57.96897, -152.5647...

[51 rows x 122 columns]

```
[29]: type(df)
```

```
[29]: geopandas.geodataframe.GeoDataFrame
```

```
[30]: df.shape
```

```
[30]: (51, 122)
```

```
[31]: df.columns
```



```
[31]: Index(['featurecla', 'scalerank', 'adm1_code', 'diss_me', 'iso_3166_2',
          'wikipedia', 'iso_a2', 'adm0_sr', 'name', 'name_alt',
          ...
          'FCLASS_ID', 'FCLASS_PL', 'FCLASS_GR', 'FCLASS_IT', 'FCLASS_NL',
          'FCLASS_SE', 'FCLASS_BD', 'FCLASS_UA', 'FCLASS_TLC', 'geometry'],
          dtype='object', length=122)
```

```
[32]: df.loc[0]
```

```
[32]: featurecla          Admin-1 scale rank
scalerank                2
adm1_code              USA-3514
diss_me                3514
iso_3166_2             US-MN
...
FCLASS_SE              None
FCLASS_BD              None
FCLASS_UA              None
FCLASS_TLC             None
geometry    POLYGON ((-89.95765601272012 47.28690725360318...
Name: 0, Length: 122, dtype: object
```

```
[33]: df['name']
```

```
[33]: 0      Minnesota
1      Montana
2      North Dakota
3      Hawaii
4      Idaho
5      Washington
6      Arizona
7      California
8      Colorado
9      Nevada
10     New Mexico
11     Oregon
12     Utah
13     Wyoming
14     Arkansas
15     Iowa
16     Kansas
17     Missouri
18     Nebraska
19     Oklahoma
20     South Dakota
21     Louisiana
22     Texas
```

```

23         Connecticut
24     Massachusetts
25     New Hampshire
26         Rhode Island
27         Vermont
28         Alabama
29         Florida
30         Georgia
31     Mississippi
32     South Carolina
33         Illinois
34         Indiana
35         Kentucky
36     North Carolina
37         Ohio
38         Tennessee
39         Virginia
40         Wisconsin
41     West Virginia
42         Delaware
43     District of Columbia
44         Maryland
45         New Jersey
46         New York
47         Pennsylvania
48         Maine
49         Michigan
50         Alaska

```

Name: name, dtype: object

```
[34]: california = df.loc[df['name'] == "California"]
california
```

```

[34]:          featurecla  scalerank adm1_code  diss_me iso_3166_2  \
7  Admin-1 scale rank          2  USA-3521    3521    US-CA

          wikipedia iso_a2  adm0_sr          name  \
7  http://en.wikipedia.org/wiki/California    US          8  California

          name_alt  ... FCLASS_ID FCLASS_PL FCLASS_GR FCLASS_IT FCLASS_NL FCLASS_SE  \
7  CA|Calif.  ...      None      None      None      None      None      None

          FCLASS_BD FCLASS_UA FCLASS_TLC  \
7      None      None      None

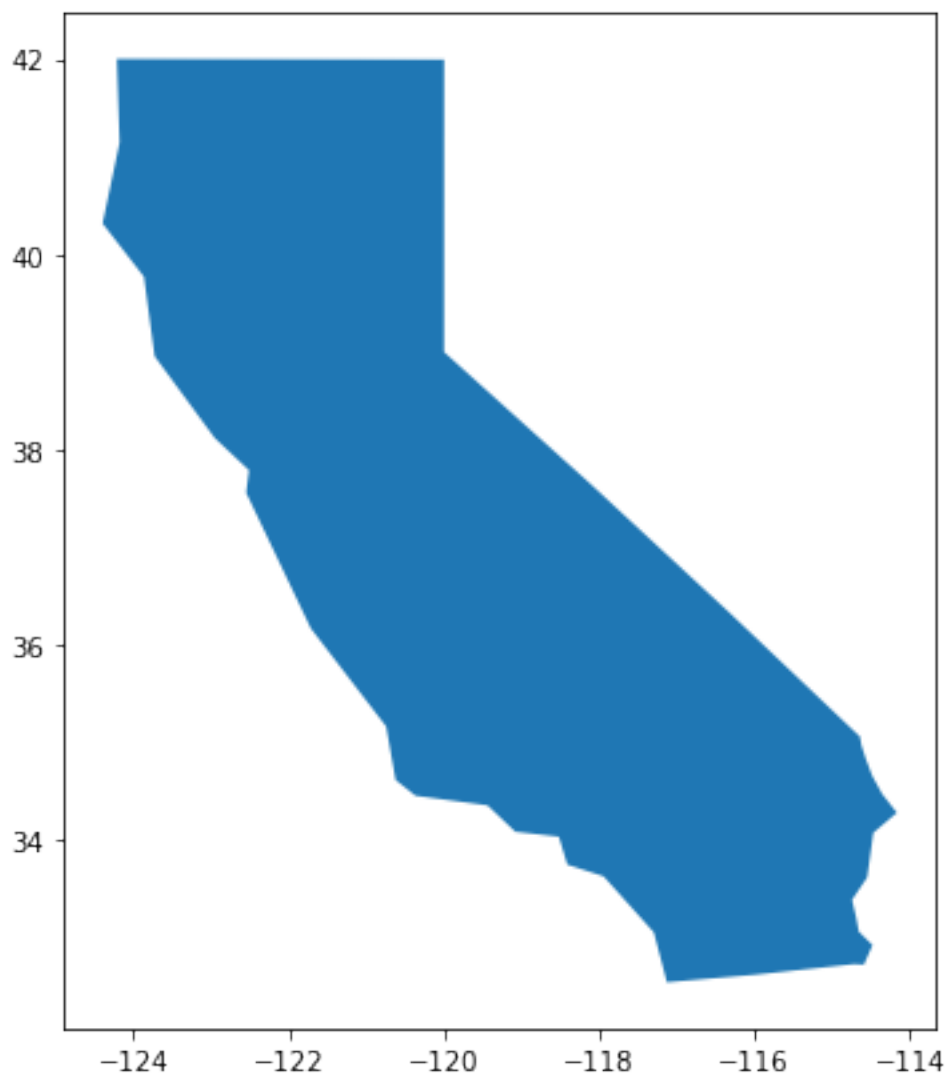
          geometry
7  POLYGON ((-114.64222 35.05311, -114.62212 34.9...

```

[1 rows x 122 columns]

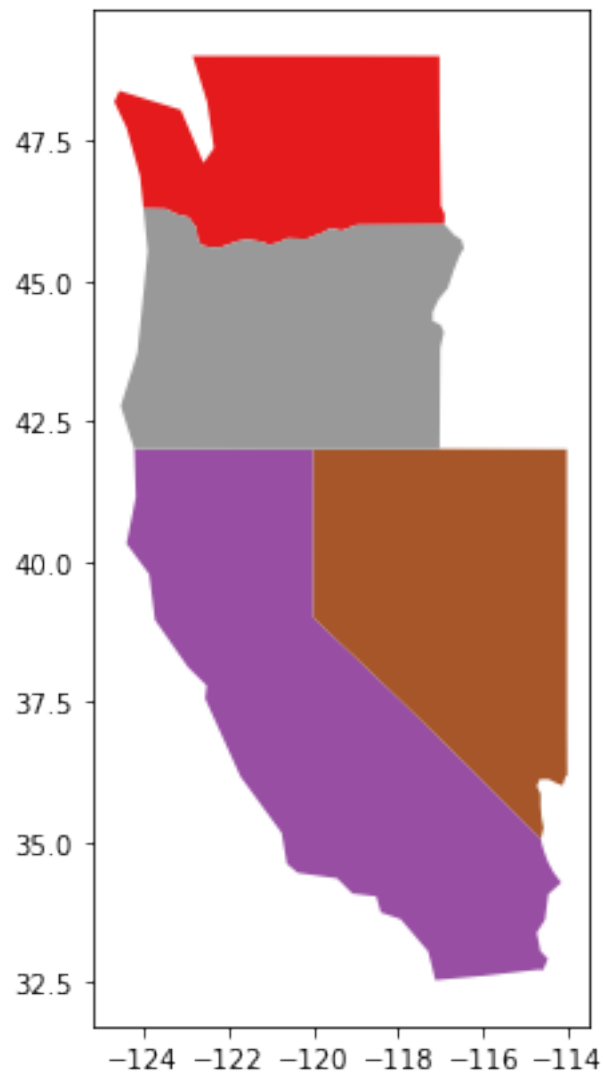
```
[35]: california.plot(figsize=(7,7))
```

```
[35]: <matplotlib.axes._subplots.AxesSubplot at 0x7b3114127950>
```



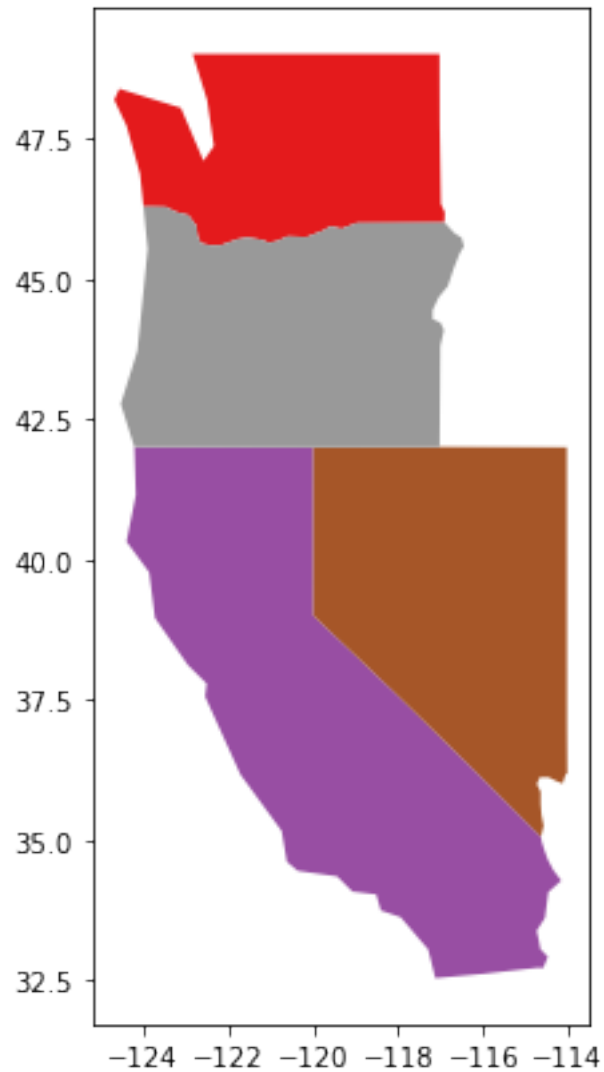
```
[36]: multipl = df.iloc[[5,7,9,11]]
      multipl.plot(cmap="Set1", figsize=(7,7))
```

```
[36]: <matplotlib.axes._subplots.AxesSubplot at 0x7b310e1e0a90>
```



```
[37]: exp = df.cx[-124:-118,30:50]
exp.plot(cmap="Set1", figsize=(7,7))
```

```
[37]: <matplotlib.axes._subplots.AxesSubplot at 0x7b310e1eb9d0>
```



```
[38]: import geopandas
```

```
[39]: states = geopandas.read_file(r"Data/110m_cultural/
↳ne_110m_admin_1_states_provinces.shp")
```

```
[40]: states
```

```
[40]:
```

	featurecla	scalerank	adm1_code	diss_me	iso_3166_2	\
0	Admin-1 scale rank	2	USA-3514	3514	US-MN	
1	Admin-1 scale rank	2	USA-3515	3515	US-MT	
2	Admin-1 scale rank	2	USA-3516	3516	US-ND	
3	Admin-1 scale rank	2	USA-3517	3517	US-HI	
4	Admin-1 scale rank	2	USA-3518	3518	US-ID	
5	Admin-1 scale rank	2	USA-3519	3519	US-WA	

6	Admin-1 scale rank	2	USA-3520	3520	US-AZ
7	Admin-1 scale rank	2	USA-3521	3521	US-CA
8	Admin-1 scale rank	2	USA-3522	3522	US-CO
9	Admin-1 scale rank	2	USA-3523	3523	US-NV
10	Admin-1 scale rank	2	USA-3524	3524	US-NM
11	Admin-1 scale rank	2	USA-3525	3525	US-OR
12	Admin-1 scale rank	2	USA-3526	3526	US-UT
13	Admin-1 scale rank	2	USA-3527	3527	US-WY
14	Admin-1 scale rank	2	USA-3528	3528	US-AR
15	Admin-1 scale rank	2	USA-3529	3529	US-IA
16	Admin-1 scale rank	2	USA-3530	3530	US-KS
17	Admin-1 scale rank	2	USA-3531	3531	US-MO
18	Admin-1 scale rank	2	USA-3532	3532	US-NE
19	Admin-1 scale rank	2	USA-3533	3533	US-OK
20	Admin-1 scale rank	2	USA-3534	3534	US-SD
21	Admin-1 scale rank	2	USA-3535	3535	US-LA
22	Admin-1 scale rank	2	USA-3536	3536	US-TX
23	Admin-1 scale rank	2	USA-3537	3537	US-CT
24	Admin-1 scale rank	2	USA-3513	3513	US-MA
25	Admin-1 scale rank	2	USA-3538	3538	US-NH
26	Admin-1 scale rank	2	USA-3539	3539	US-RI
27	Admin-1 scale rank	2	USA-3540	3540	US-VT
28	Admin-1 scale rank	2	USA-3541	3541	US-AL
29	Admin-1 scale rank	2	USA-3542	3542	US-FL
30	Admin-1 scale rank	2	USA-3543	3543	US-GA
31	Admin-1 scale rank	2	USA-3544	3544	US-MS
32	Admin-1 scale rank	2	USA-3545	3545	US-SC
33	Admin-1 scale rank	2	USA-3546	3546	US-IL
34	Admin-1 scale rank	2	USA-3547	3547	US-IN
35	Admin-1 scale rank	2	USA-3548	3548	US-KY
36	Admin-1 scale rank	2	USA-3549	3549	US-NC
37	Admin-1 scale rank	2	USA-3550	3550	US-OH
38	Admin-1 scale rank	2	USA-3551	3551	US-TN
39	Admin-1 scale rank	2	USA-3552	3552	US-VA
40	Admin-1 scale rank	2	USA-3553	3553	US-WI
41	Admin-1 scale rank	2	USA-3554	3554	US-WV
42	Admin-1 scale rank	2	USA-3555	3555	US-DE
43	Admin-1 scale rank	2	USA-3556	3556	US-DC
44	Admin-1 scale rank	2	USA-3557	3557	US-MD
45	Admin-1 scale rank	2	USA-3558	3558	US-NJ
46	Admin-1 scale rank	2	USA-3559	3559	US-NY
47	Admin-1 scale rank	2	USA-3560	3560	US-PA
48	Admin-1 scale rank	2	USA-3561	3561	US-ME
49	Admin-1 scale rank	2	USA-3562	3562	US-MI
50	Admin-1 scale rank	2	USA-3563	3563	US-AK

wikipedia iso\_a2 adm0\_sr \

0	<a href="http://en.wikipedia.org/wiki/Minnesota">http://en.wikipedia.org/wiki/Minnesota</a>	US	1
1	<a href="http://en.wikipedia.org/wiki/Montana">http://en.wikipedia.org/wiki/Montana</a>	US	1
2	<a href="http://en.wikipedia.org/wiki/North_Dakota">http://en.wikipedia.org/wiki/North_Dakota</a>	US	1
3	<a href="http://en.wikipedia.org/wiki/Hawaii">http://en.wikipedia.org/wiki/Hawaii</a>	US	8
4	<a href="http://en.wikipedia.org/wiki/Idaho">http://en.wikipedia.org/wiki/Idaho</a>	US	1
5	<a href="http://en.wikipedia.org/wiki/Washington_(state)">http://en.wikipedia.org/wiki/Washington_(state)</a>	US	6
6	<a href="http://en.wikipedia.org/wiki/Arizona">http://en.wikipedia.org/wiki/Arizona</a>	US	1
7	<a href="http://en.wikipedia.org/wiki/California">http://en.wikipedia.org/wiki/California</a>	US	8
8	<a href="http://en.wikipedia.org/wiki/Colorado">http://en.wikipedia.org/wiki/Colorado</a>	US	1
9	<a href="http://en.wikipedia.org/wiki/Nevada">http://en.wikipedia.org/wiki/Nevada</a>	US	1
10	<a href="http://en.wikipedia.org/wiki/New_Mexico">http://en.wikipedia.org/wiki/New_Mexico</a>	US	1
11	<a href="http://en.wikipedia.org/wiki/Oregon">http://en.wikipedia.org/wiki/Oregon</a>	US	6
12	<a href="http://en.wikipedia.org/wiki/Utah">http://en.wikipedia.org/wiki/Utah</a>	US	1
13	<a href="http://en.wikipedia.org/wiki/Wyoming">http://en.wikipedia.org/wiki/Wyoming</a>	US	1
14	<a href="http://en.wikipedia.org/wiki/Arkansas">http://en.wikipedia.org/wiki/Arkansas</a>	US	1
15	<a href="http://en.wikipedia.org/wiki/Iowa">http://en.wikipedia.org/wiki/Iowa</a>	US	1
16	<a href="http://en.wikipedia.org/wiki/Kansas">http://en.wikipedia.org/wiki/Kansas</a>	US	1
17	<a href="http://en.wikipedia.org/wiki/Missouri">http://en.wikipedia.org/wiki/Missouri</a>	US	1
18	<a href="http://en.wikipedia.org/wiki/Nebraska">http://en.wikipedia.org/wiki/Nebraska</a>	US	1
19	<a href="http://en.wikipedia.org/wiki/Oklahoma">http://en.wikipedia.org/wiki/Oklahoma</a>	US	1
20	<a href="http://en.wikipedia.org/wiki/South_Dakota">http://en.wikipedia.org/wiki/South_Dakota</a>	US	1
21	<a href="http://en.wikipedia.org/wiki/Louisiana">http://en.wikipedia.org/wiki/Louisiana</a>	US	5
22	<a href="http://en.wikipedia.org/wiki/Texas">http://en.wikipedia.org/wiki/Texas</a>	US	4
23	<a href="http://en.wikipedia.org/wiki/Connecticut">http://en.wikipedia.org/wiki/Connecticut</a>	US	1
24	<a href="http://en.wikipedia.org/wiki/Massachusetts">http://en.wikipedia.org/wiki/Massachusetts</a>	US	6
25	<a href="http://en.wikipedia.org/wiki/New_Hampshire">http://en.wikipedia.org/wiki/New_Hampshire</a>	US	1
26	<a href="http://en.wikipedia.org/wiki/Rhode_Island">http://en.wikipedia.org/wiki/Rhode_Island</a>	US	6
27	<a href="http://en.wikipedia.org/wiki/Vermont">http://en.wikipedia.org/wiki/Vermont</a>	US	1
28	<a href="http://en.wikipedia.org/wiki/Alabama">http://en.wikipedia.org/wiki/Alabama</a>	US	5
29	<a href="http://en.wikipedia.org/wiki/Florida">http://en.wikipedia.org/wiki/Florida</a>	US	5
30	<a href="http://en.wikipedia.org/wiki/Georgia_(U.S._state)">http://en.wikipedia.org/wiki/Georgia_(U.S._state)</a>	US	6
31	<a href="http://en.wikipedia.org/wiki/Mississippi">http://en.wikipedia.org/wiki/Mississippi</a>	US	5
32	<a href="http://en.wikipedia.org/wiki/South_Carolina">http://en.wikipedia.org/wiki/South_Carolina</a>	US	1
33	<a href="http://en.wikipedia.org/wiki/Illinois">http://en.wikipedia.org/wiki/Illinois</a>	US	1
34	<a href="http://en.wikipedia.org/wiki/Indiana">http://en.wikipedia.org/wiki/Indiana</a>	US	1
35	<a href="http://en.wikipedia.org/wiki/Kentucky">http://en.wikipedia.org/wiki/Kentucky</a>	US	1
36	<a href="http://en.wikipedia.org/wiki/North_Carolina">http://en.wikipedia.org/wiki/North_Carolina</a>	US	5
37	<a href="http://en.wikipedia.org/wiki/Ohio">http://en.wikipedia.org/wiki/Ohio</a>	US	1
38	<a href="http://en.wikipedia.org/wiki/Tennessee">http://en.wikipedia.org/wiki/Tennessee</a>	US	1
39	<a href="http://en.wikipedia.org/wiki/Virginia">http://en.wikipedia.org/wiki/Virginia</a>	US	6
40	<a href="http://en.wikipedia.org/wiki/Wisconsin">http://en.wikipedia.org/wiki/Wisconsin</a>	US	1
41	<a href="http://en.wikipedia.org/wiki/West_Virginia">http://en.wikipedia.org/wiki/West_Virginia</a>	US	1
42	<a href="http://en.wikipedia.org/wiki/Delaware">http://en.wikipedia.org/wiki/Delaware</a>	US	1
43	<a href="http://en.wikipedia.org/wiki/Washington,_D.C.">http://en.wikipedia.org/wiki/Washington,_D.C.</a>	US	1
44	<a href="http://en.wikipedia.org/wiki/Maryland">http://en.wikipedia.org/wiki/Maryland</a>	US	1
45	<a href="http://en.wikipedia.org/wiki/New_Jersey">http://en.wikipedia.org/wiki/New_Jersey</a>	US	5
46	<a href="http://en.wikipedia.org/wiki/New_York">http://en.wikipedia.org/wiki/New_York</a>	US	3

47	<a href="http://en.wikipedia.org/wiki/Pennsylvania">http://en.wikipedia.org/wiki/Pennsylvania</a>	US	1
48	<a href="http://en.wikipedia.org/wiki/Maine">http://en.wikipedia.org/wiki/Maine</a>	US	6
49	<a href="http://en.wikipedia.org/wiki/Michigan">http://en.wikipedia.org/wiki/Michigan</a>	US	1
50	<a href="http://en.wikipedia.org/wiki/Alaska">http://en.wikipedia.org/wiki/Alaska</a>	US	6
	name		name_alt \
0	Minnesota		MN Minn.
1	Montana		MT Mont.
2	North Dakota		ND N.D.
3	Hawaii		HI Hawaii
4	Idaho		ID Idaho
5	Washington		WA Wash.
6	Arizona		AZ Ariz.
7	California		CA Calif.
8	Colorado		CO Colo.
9	Nevada		NV Nev.
10	New Mexico		NM N.M.
11	Oregon		OR Ore.
12	Utah		UT
13	Wyoming		WY Wyo.
14	Arkansas		AR Ark.
15	Iowa		IA Iowa
16	Kansas		KS Kans.
17	Missouri		MO
18	Nebraska		NE Nebr.
19	Oklahoma		OK Okla.
20	South Dakota		SD S.D.
21	Louisiana		LA
22	Texas		TX Tex.
23	Connecticut		CT Conn.
24	Massachusetts	Commonwealth of Massachusetts	MA Mass.
25	New Hampshire		NH N.H.
26	Rhode Island	State of Rhode Island and Providence Plantatio...	
27	Vermont		VT
28	Alabama		AL Ala.
29	Florida		FL Fla.
30	Georgia		GA Ga.
31	Mississippi		MS Miss.
32	South Carolina		SC S.C.
33	Illinois		IL Ill.
34	Indiana		IN Ind.
35	Kentucky	Commonwealth of Kentucky	KY
36	North Carolina		NC N.C.
37	Ohio		OH Ohio
38	Tennessee		TN Tenn.
39	Virginia		VA
40	Wisconsin		WI Wis.



41	West Virginia	WV W.Va.
42	Delaware	DE Del.
43	District of Columbia	DC D.C.
44	Maryland	MD
45	New Jersey	NJ N.J.
46	New York	NY N.Y.
47	Pennsylvania	Commonwealth of Pennsylvania PA
48	Maine	ME Maine
49	Michigan	MI Mich.
50	Alaska	AK Alaska

	...	FCLASS_ID	FCLASS_PL	FCLASS_GR	FCLASS_IT	FCLASS_NL	FCLASS_SE	FCLASS_BD	\
0	...	None	None	None	None	None	None	None	
1	...	None	None	None	None	None	None	None	
2	...	None	None	None	None	None	None	None	
3	...	None	None	None	None	None	None	None	
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8	...	None	None	None	None	None	None	None	
9	...	None	None	None	None	None	None	None	
10	...	None	None	None	None	None	None	None	
11	...	None	None	None	None	None	None	None	
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16	...	None	None	None	None	None	None	None	
17	...	None	None	None	None	None	None	None	
18	...	None	None	None	None	None	None	None	
19	...	None	None	None	None	None	None	None	
20	...	None	None	None	None	None	None	None	
21	...	None	None	None	None	None	None	None	
22	...	None	None	None	None	None	None	None	
23	...	None	None	None	None	None	None	None	
24	...	None	None	None	None	None	None	None	
25	...	None	None	None	None	None	None	None	
26	...	None	None	None	None	None	None	None	
27	...	None	None	None	None	None	None	None	
28	...	None	None	None	None	None	None	None	
29	...	None	None	None	None	None	None	None	
30	...	None	None	None	None	None	None	None	
31	...	None	None	None	None	None	None	None	
32	...	None	None	None	None	None	None	None	
33	...	None	None	None	None	None	None	None	
34	...	None	None	None	None	None	None	None	

35	...	None	None	None	None	None	None
36	...	None	None	None	None	None	None
37	...	None	None	None	None	None	None
38	...	None	None	None	None	None	None
39	...	None	None	None	None	None	None
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42	...	None	None	None	None	None	None
43	...	None	None	None	None	None	None
44	...	None	None	None	None	None	None
45	...	None	None	None	None	None	None
46	...	None	None	None	None	None	None
47	...	None	None	None	None	None	None
48	...	None	None	None	None	None	None
49	...	None	None	None	None	None	None
50	...	None	None	None	None	None	None

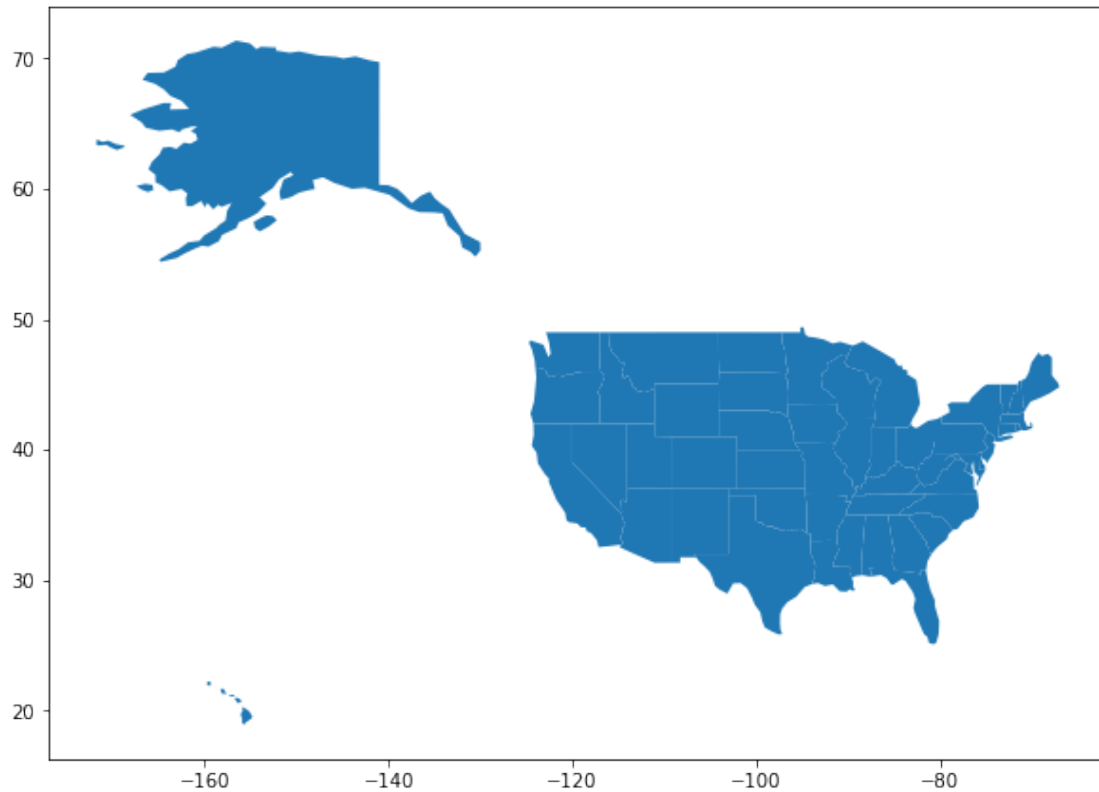
	FCLASS_UA	FCLASS_TLC	geometry
0	None	None	POLYGON (((-89.95766 47.28691, -90.13175 47.292...
1	None	None	POLYGON (((-116.04823 49.00037, -113.05950 49.0...
2	None	None	POLYGON (((-97.22894 49.00089, -97.21414 48.902...
3	None	None	MULTIPOLYGON (((-155.93665 19.05939, -155.9080...
4	None	None	POLYGON (((-116.04823 49.00037, -115.96780 47.9...
5	None	None	POLYGON (((-117.03143 48.99931, -117.02665 47.7...
6	None	None	POLYGON (((-109.04522 36.99991, -109.04367 31.3...
7	None	None	POLYGON (((-114.64222 35.05311, -114.62212 34.9...
8	None	None	POLYGON (((-102.05017 40.00081, -102.04012 38.4...
9	None	None	POLYGON (((-117.02825 42.00002, -114.03422 41.9...
10	None	None	POLYGON (((-109.04367 31.34190, -109.04522 36.9...
11	None	None	POLYGON (((-116.91500 45.99998, -116.67900 45.8...
12	None	None	POLYGON (((-114.03422 41.99312, -111.05024 42.0...
13	None	None	POLYGON (((-111.08518 44.50615, -111.06719 44.5...
14	None	None	POLYGON (((-89.66292 36.02307, -89.67351 35.940...
15	None	None	POLYGON (((-96.45266 43.50179, -95.35994 43.500...
16	None	None	POLYGON (((-102.04118 36.99198, -102.04012 38.4...
17	None	None	POLYGON (((-89.66292 36.02307, -90.31539 36.023...
18	None	None	POLYGON (((-102.05017 40.00081, -102.05017 40.0...
19	None	None	POLYGON (((-103.00322 36.99516, -102.04118 36.9...
20	None	None	POLYGON (((-96.53945 46.01797, -96.55689 45.872...
21	None	None	POLYGON (((-94.05976 33.01212, -93.09403 33.010...
22	None	None	POLYGON (((-106.50734 31.75429, -106.61953 31.9...
23	None	None	POLYGON (((-73.49794 42.05451, -72.73222 42.035...
24	None	None	POLYGON (((-71.80091 42.01325, -72.73222 42.035...
25	None	None	POLYGON (((-70.81505 42.86519, -70.93360 42.884...
26	None	None	POLYGON (((-71.85383 41.32004, -71.79295 41.466...
27	None	None	POLYGON (((-72.45707 42.72708, -73.28203 42.743...
28	None	None	POLYGON (((-88.16696 34.99967, -86.90968 34.999...

29	None	None	POLYGON ((-87.53039 30.27420, -87.45789 30.411...
30	None	None	POLYGON ((-85.00519 30.99069, -85.05442 31.108...
31	None	None	POLYGON ((-91.15624 33.01000, -91.10808 33.206...
32	None	None	POLYGON ((-80.86501 32.03316, -81.03644 32.084...
33	None	None	POLYGON ((-91.43033 40.36860, -91.41023 40.551...
34	None	None	POLYGON ((-88.05108 37.81960, -88.01881 38.021...
35	None	None	POLYGON ((-89.49836 36.50620, -89.27398 36.611...
36	None	None	POLYGON ((-83.07637 34.97903, -84.32097 34.986...
37	None	None	POLYGON ((-84.82368 39.10653, -84.81787 39.799...
38	None	None	POLYGON ((-90.24924 35.02083, -90.13493 35.113...
39	None	None	MULTIPOLYGON (((-83.33059 36.67266, -83.17851 ...
40	None	None	POLYGON ((-91.22820 43.50125, -91.25466 43.613...
41	None	None	POLYGON ((-81.97254 37.53595, -82.16728 37.554...
42	None	None	POLYGON ((-75.04839 38.44876, -75.71462 38.449...
43	None	None	POLYGON ((-77.04124 38.78954, -77.04123 38.789...
44	None	None	POLYGON ((-75.37754 38.01538, -75.37754 38.015...
45	None	None	POLYGON ((-75.52781 39.49865, -75.55427 39.691...
46	None	None	POLYGON ((-73.49794 42.05451, -73.55349 41.289...
47	None	None	POLYGON ((-80.51893 40.64111, -80.51627 42.324...
48	None	None	POLYGON ((-70.64573 43.09008, -70.75102 43.080...
49	None	None	POLYGON ((-89.95766 47.28691, -89.84283 47.464...
50	None	None	MULTIPOLYGON (((-153.22873 57.96897, -152.5647...

[51 rows x 122 columns]

```
[41]: %matplotlib inline
states.plot(figsize=(10,10))
```

[41]: <matplotlib.axes.\_subplots.AxesSubplot at 0x7b310e187b90>



```
[42]: fires = geopandas.read_file(r"Data/mtbs_FODpoints_DD/mtbs_FODpoints_DD.shp")
fires
```

```
[42]:
```

	Event_ID	irwinID \
0	AK6448214467319840607	None
1	SD4308410285019840906	None
2	MT4880411345819840819	None
3	MT4533610695819840826	None
4	MT4561710632319840918	None
...	...	...
30413	AL3403308569720210307	4AEFD78F-C2BE-470C-AB5F-1B0918A84A23
30414	FL2862308067720200715	A7B0E005-54EE-4827-A962-59495C4B0623
30415	SC3450308143420210307	None
30416	AZ3415810972420210707	F1B3DE00-D58E-40FF-AF91-CE3C84389F80
30417	MT4566510682820210810	996C6346-4C63-4FA8-A193-770E1DE76344

	Incid_Name	Incid_Type	Map_ID	Map_Prog	Asmnt_Type \
0	GLACIER CREEK	Wildfire	4534	MTBS	Initial (SS)
1	SANDOZ	Wildfire	4535	MTBS	Initial
2	NAPI PEAK	Wildfire	4536	MTBS	Extended
3	KIRBY	Wildfire	4537	MTBS	Extended

4	LAKE CREEK	Wildfire	4538	MTBS	Initial
...	...	...	...	...	...
30413	MT WIESNER	Wildfire	10024251	MTBS	Extended
30414	FMU 5.1 C AND D	Prescribed Fire	10024252	MTBS	Initial
30415	UNNAMED	Prescribed Fire	10024253	MTBS	Initial
30416	FIREBOX	Wildfire	10024338	MTBS	Extended
30417	LAME DEER	Wildfire	10024341	MTBS	Initial

	BurnBndAc	BurnBndLat	BurnBndLon	...	dNBR_offst	dNBR_stdDv	NoData_T	\
0	1897	64.482	-144.673	...	-9999	-9999	9999	
1	2691	43.084	-102.850	...	211	-9999	-970	
2	3680	48.804	-113.458	...	-62	-9999	-970	
3	1597	45.336	-106.958	...	52	-9999	-970	
4	3617	45.617	-106.323	...	-104	-9999	-970	
...	...	...	...	...	...	...	...	
30413	1905	34.019	-85.687	...	16	16	-970	
30414	914	28.641	-80.69	...	18	15	-970	
30415	645	34.504	-81.435	...	-5	13	-970	
30416	1075	34.157	-109.732	...	11	29	-970	
30417	5470	45.644	-106.775	...	50	26	-970	

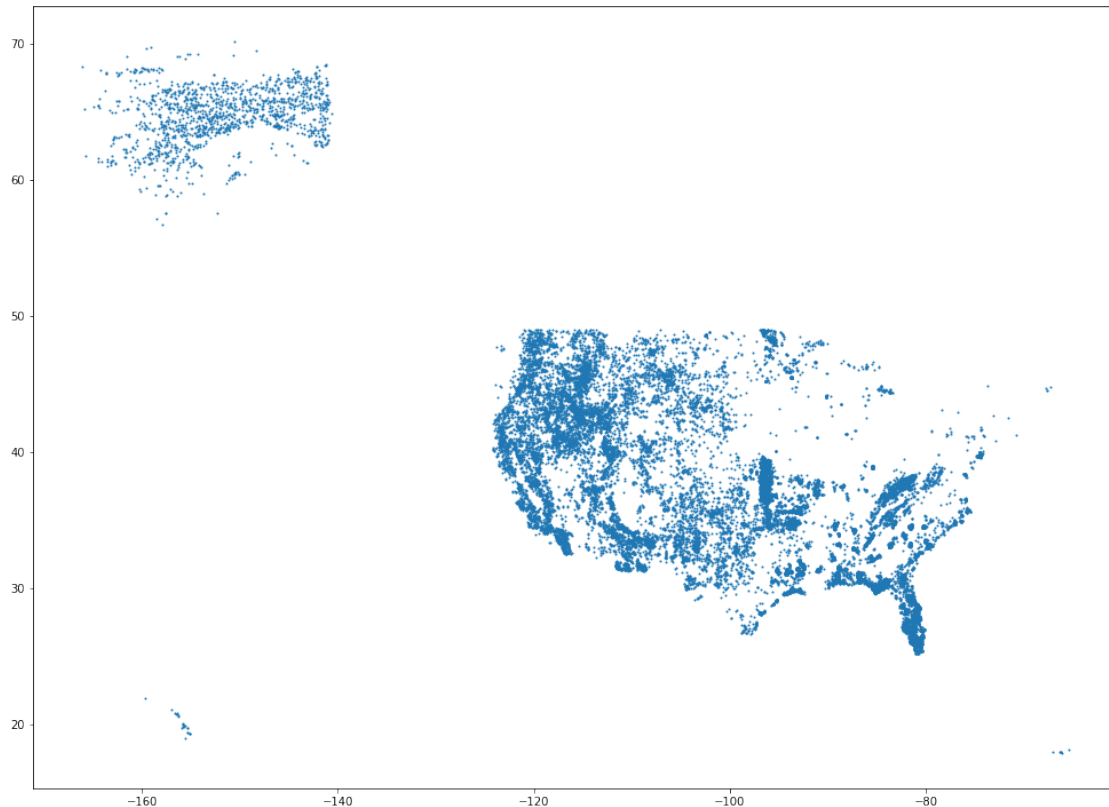
	IncGreen_T	Low_T	Mod_T	High_T	Comment	ORIG_FID	\
0	9999	550	165	-20	None	0	
1	-150	220	700	9999	None	1	
2	-150	160	308	515	None	2	
3	-150	150	309	525	None	3	
4	-150	-50	175	9999	None	4	
...	...	...	...	...	...	...	
30413	-150	20	9999	9999	None	30413	
30414	-150	55	9999	9999	None	30414	
30415	-150	20	9999	9999	None	30415	
30416	-150	50	313	600	None	30416	
30417	-150	110	375	9999	None	30417	

	geometry
0	POINT (-144.67325 64.48231)
1	POINT (-102.84988 43.08393)
2	POINT (-113.45772 48.80434)
3	POINT (-106.95829 45.33640)
4	POINT (-106.32284 45.61684)
...	...
30413	POINT (-85.68731 34.01841)
30414	POINT (-80.68930 28.64502)
30415	POINT (-81.43491 34.50382)
30416	POINT (-109.73103 34.15523)
30417	POINT (-106.77410 45.64768)

[30418 rows x 24 columns]

```
[43]: fires.plot(markersize=1, figsize=(17,17))
```

```
[43]: <matplotlib.axes._subplots.AxesSubplot at 0x7b310e18b2d0>
```



```
[44]: fires.crs
```

```
[44]: <Geographic 2D CRS: EPSG:4269>
```

Name: NAD83

Axis Info [ellipsoidal]:

- Lat[north]: Geodetic latitude (degree)

- Lon[east]: Geodetic longitude (degree)

Area of Use:

- name: North America - onshore and offshore: Canada - Alberta; British Columbia; Manitoba; New Brunswick; Newfoundland and Labrador; Northwest Territories; Nova Scotia; Nunavut; Ontario; Prince Edward Island; Quebec; Saskatchewan; Yukon. Puerto Rico. United States (USA) - Alabama; Alaska; Arizona; Arkansas; California; Colorado; Connecticut; Delaware; Florida; Georgia; Hawaii; Idaho; Illinois; Indiana; Iowa; Kansas; Kentucky; Louisiana; Maine; Maryland; Massachusetts; Michigan; Minnesota; Mississippi; Missouri;

Montana; Nebraska; Nevada; New Hampshire; New Jersey; New Mexico; New York; North Carolina; North Dakota; Ohio; Oklahoma; Oregon; Pennsylvania; Rhode Island; South Carolina; South Dakota; Tennessee; Texas; Utah; Vermont; Virginia; Washington; West Virginia; Wisconsin; Wyoming. US Virgin Islands. British Virgin Islands.

- bounds: (167.65, 14.92, -47.74, 86.46)

Datum: North American Datum 1983

- Ellipsoid: GRS 1980

- Prime Meridian: Greenwich

```
[45]: states.crs
```

```
[45]: <Geographic 2D CRS: EPSG:4326>
```

Name: WGS 84

Axis Info [ellipsoidal]:

- Lat[north]: Geodetic latitude (degree)

- Lon[east]: Geodetic longitude (degree)

Area of Use:

- name: World.

- bounds: (-180.0, -90.0, 180.0, 90.0)

Datum: World Geodetic System 1984 ensemble

- Ellipsoid: WGS 84

- Prime Meridian: Greenwich

```
[46]: fires = fires.to_crs("epsg:4326")
```

```
[47]: state_fires = geopandas.sjoin(fires,states[['name','geometry']].
```

```
    ↳copy(),op='within')
```

```
state_fires
```

/opt/conda/lib/python3.7/site-packages/IPython/core/interactiveshell.py:3242:  
FutureWarning: The `op` parameter is deprecated and will be removed in a future  
release. Please use the `predicate` parameter instead.

```
    if (await self.run_code(code, result,  async_=asy)):
```

```
[47]:
```

	Event_ID	irwinID \
0	AK6448214467319840607	None
11	AK6393015752719840606	None
12	AK6375715753719840609	None
13	AK6535415457219840611	None
14	AK6640915520219840617	None
...	...	...
16992	OH3869908322420090424	None
28175	OH3861408255620190322	DB43038A-5584-4163-B1D1-E7A6F878F79B
29456	OH3948808216720210324	4BA45C3A-34FE-44E4-976F-B5D1FAF86CAB
11907	MA4250107165620050416	None
29401	MA4273407316920210514	ODFC1976-D66F-40EA-B769-734EA8E42F99

	Incid_Name	Incid_Type	Map_ID	Map_Prog	\
0	GLACIER CREEK	Wildfire	4534	MTBS	
11	MUD FIRE	Wildfire	4545	MTBS	
12	WAPOO FIRE	Wildfire	4546	MTBS	
13	414008	Wildfire	4547	MTBS	
14	HUS NW 30	Wildfire	4548	MTBS	
...	...	...	...		
16992	UNNAMED	Wildfire	18381	MTBS	
28175	CY19 BLUEGRASS PRESCRIBED BURN	Prescribed Fire	10017178	MTBS	
29456	LONG RIDGE RX UNIT 1-12	Prescribed Fire	10021862	MTBS	
11907	THE RANGE	Wildfire	14408	MTBS	
29401	EAST MOUNTAIN	Wildfire	10021537	MTBS	

	Asmnt_Type	BurnBndAc	BurnBndLat	BurnBndLon	...	NoData_T	\
0	Initial (SS)	1897	64.482	-144.673	...	9999	
11	Extended (SS)	10243	63.930	-157.527	...	9999	
12	Extended (SS)	37083	63.757	-157.537	...	9999	
13	Extended (SS)	3169	65.354	-154.572	...	9999	
14	Extended (SS)	1990	66.409	-155.202	...	9999	
...	...	...	...	...	...		
16992	Initial	3259	38.699	-83.224	...	-970	
28175	Initial	1190	38.617	-82.542	...	-970	
29456	Initial	1037	39.487	-82.181	...	-970	
11907	Initial	760	42.501	-71.656	...	-970	
29401	Initial	964	42.723	-73.157	...	-970	

	IncGreen_T	Low_T	Mod_T	High_T	\
0	9999	550	165	-20	
11	9999	475	335	225	
12	9999	450	300	200	
13	9999	500	260	-9999	
14	9999	490	140	325	
...	...	...	...		
16992	-150	70	299	560	
28175	-150	20	215	9999	
29456	-150	75	9999	9999	
11907	-150	150	9999	9999	
29401	-150	25	9999	9999	

	Comment	ORIG_FID	\
0	None	0	
11	Hard to determine fire perimeter	11	
12	None	12	
13	Perimeter difficult to delineate.	13	
14	None	14	
...	...	...	



16992		None	16992
28175	Revised 06/02/2021 - adjusted thresholds, remo...		28175
29456		None	29456
11907		None	11907
29401		None	29401

	geometry	index_right	name
0	POINT (-144.67325 64.48231)	50	Alaska
11	POINT (-157.52685 63.92986)	50	Alaska
12	POINT (-157.53652 63.75710)	50	Alaska
13	POINT (-154.57250 65.35357)	50	Alaska
14	POINT (-155.20182 66.40871)	50	Alaska
...	...	...	...
16992	POINT (-83.22436 38.69879)	37	Ohio
28175	POINT (-82.54279 38.61839)	37	Ohio
29456	POINT (-82.17959 39.48788)	37	Ohio
11907	POINT (-71.64979 42.49544)	24	Massachusetts
29401	POINT (-73.15671 42.72522)	24	Massachusetts

[30291 rows x 26 columns]

```
[48]: counts_per_state = state_fires.groupby('name').size()
counts_per_state.sort_values(axis=0, ascending=False)
```

```
[48]: name
Florida      5507
Kansas       1982
California   1979
Idaho        1587
Texas        1503
Alaska       1377
Arizona      1279
Oklahoma     1112
Oregon       1071
New Mexico   1039
Nevada       1036
Mississippi   909
Montana       878
Alabama       833
South Carolina 815
Louisiana     746
Utah          715
Arkansas      700
Georgia       634
Washington    590
Minnesota     521
Wyoming       449
```

Colorado	403
Kentucky	367
Missouri	315
West Virginia	311
North Carolina	303
South Dakota	243
Tennessee	210
Virginia	158
Nebraska	129
New Jersey	114
North Dakota	114
Michigan	82
Indiana	65
Wisconsin	53
Illinois	45
Maryland	40
Hawaii	22
Pennsylvania	18
Iowa	13
New York	11
Maine	4
Ohio	4
Delaware	3
Massachusetts	2

dtype: int64

```
[49]: states = states.merge(counts_per_state.reset_index(name='number_of_fires'))
states.head()
```

```
[49]:
```

	featurecla	scalerank	adm1_code	diss_me	iso_3166_2	\
0	Admin-1 scale rank	2	USA-3514	3514	US-MN	
1	Admin-1 scale rank	2	USA-3515	3515	US-MT	
2	Admin-1 scale rank	2	USA-3516	3516	US-ND	
3	Admin-1 scale rank	2	USA-3517	3517	US-HI	
4	Admin-1 scale rank	2	USA-3518	3518	US-ID	

	wikipedia	iso_a2	adm0_sr	name	\
0	<a href="http://en.wikipedia.org/wiki/Minnesota">http://en.wikipedia.org/wiki/Minnesota</a>	US	1	Minnesota	
1	<a href="http://en.wikipedia.org/wiki/Montana">http://en.wikipedia.org/wiki/Montana</a>	US	1	Montana	
2	<a href="http://en.wikipedia.org/wiki/North_Dakota">http://en.wikipedia.org/wiki/North_Dakota</a>	US	1	North Dakota	
3	<a href="http://en.wikipedia.org/wiki/Hawaii">http://en.wikipedia.org/wiki/Hawaii</a>	US	8	Hawaii	
4	<a href="http://en.wikipedia.org/wiki/Idaho">http://en.wikipedia.org/wiki/Idaho</a>	US	1	Idaho	

	name_alt	...	FCLASS_PL	FCLASS_GR	FCLASS_IT	FCLASS_NL	FCLASS_SE	FCLASS_BD	\
0	MN Minn.	...	None	None	None	None	None	None	
1	MT Mont.	...	None	None	None	None	None	None	
2	ND N.D.	...	None	None	None	None	None	None	

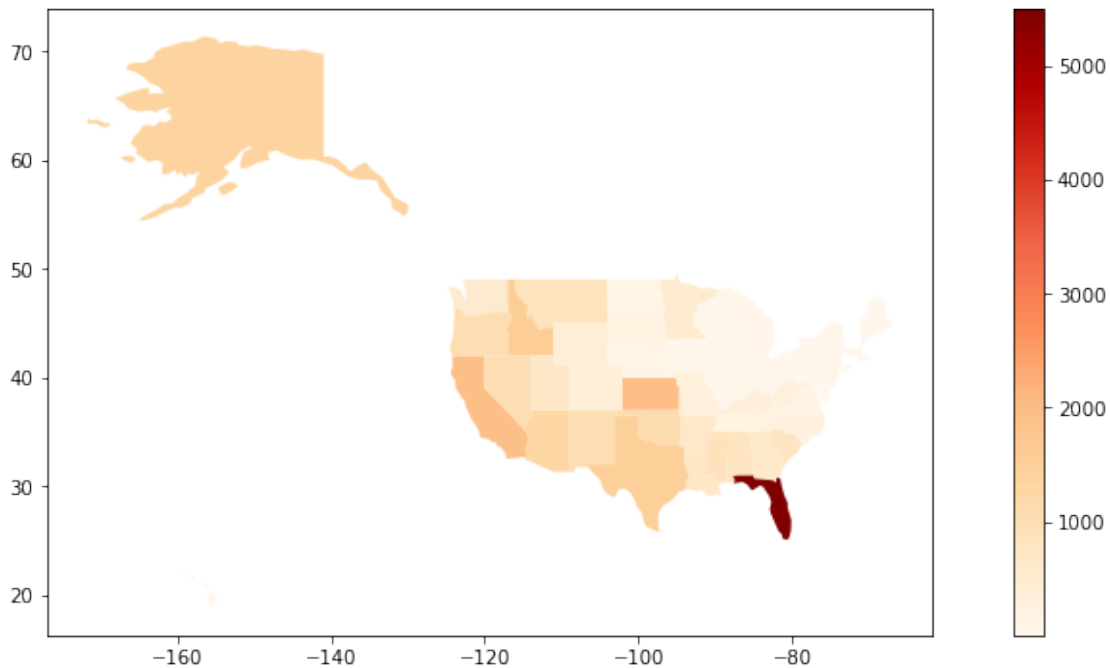
3	HI Hawaii	...	None	None	None	None	None	None
4	ID Idaho	...	None	None	None	None	None	None

	FCLASS_UA	FCLASS_TLC	geometry \
0	None	None	POLYGON ((-89.95766 47.28691, -90.13175 47.292...
1	None	None	POLYGON ((-116.04823 49.00037, -113.05950 49.0...
2	None	None	POLYGON ((-97.22894 49.00089, -97.21414 48.902...
3	None	None	MULTIPOLYGON (((-155.93665 19.05939, -155.9080...
4	None	None	POLYGON ((-116.04823 49.00037, -115.96780 47.9...

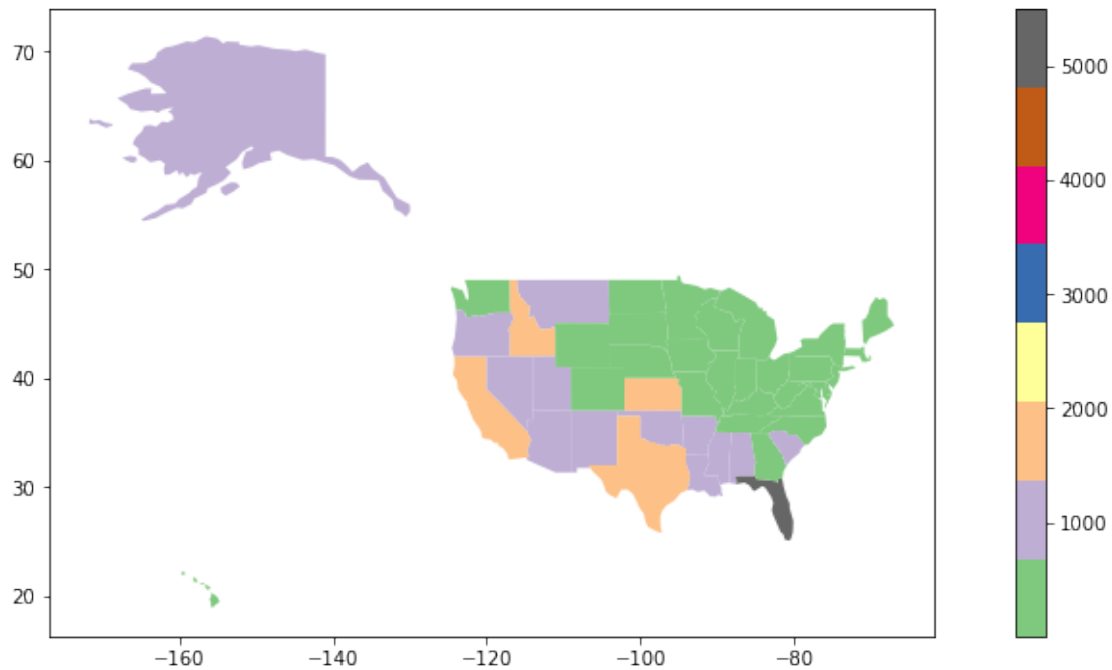
	number_of_fires
0	521
1	878
2	114
3	22
4	1587

[5 rows x 123 columns]

```
[50]: ax = states.plot(column='number_of_fires', figsize=(15, 6),
cmap='OrRd', legend=True)
```

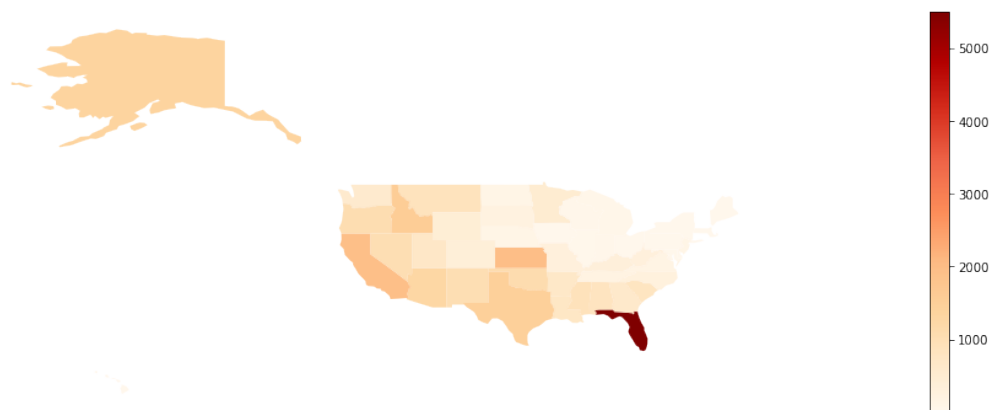


```
[51]: ax = states.plot(column='number_of_fires', figsize=(15, 6),
cmap='Accent', legend=True)
```



```
[52]: import matplotlib.pyplot as plt
f, ax = plt.subplots(1, figsize=(18,6))
ax = states.plot(column='number_of_fires', cmap='OrRd',
legend=True, ax=ax)
lims = plt.axis('equal')
f.suptitle('US Wildfire count per state in 1984-2015')
ax.set_axis_off()
plt.show()
```

US Wildfire count per state in 1984-2015



```
[53]: len(fires.index)
```

```
[53]: 30418
```

```
[54]: counts_per_state.sum()
```

```
[54]: 30291
```

```
[55]: fires.empty #checks if there are empty fields in the dataframe
```

```
[55]: False
```

```
[56]: fires['geometry'].empty
```

```
[56]: False
```

```
[ ]:
```

```
[ ]:
```

```
[ ]:
```

In this lab, I used four key Python libraries - OGR, Shapely, Fiona, and GeoPandas - to examine geographic data in depth. The investigation began with the creation of vector geometries like polygons using the OGR package. By linking together separate points, I illustrated how to define points and form polygons. In addition, I demonstrated how to read and write vector data as well as change vector geometries. I also demonstrated how to perform fundamental geometric operations such as calculating areas, centroids, and borders, as well as searching for points within a polygon. The tutorial then moved on to using Shapely and Fiona, both important library, to generate various geometries such as polygons, points, and lines. Shapely makes it easy to view geometries by simplifying the plotting process. Fiona is used for reading and interacting with shapefile. Then, it explains how to explore the data's characteristics and geometry. Following that, I learned to process more complex geospatial activities, such as spatial joins, choropleth map construction, and data inspection, using GeoPandas. These activities necessitated data reading and cleansing, as well as geographical operations to count and show wildfire occurrences by state.

Throughout the analysis, data inspection played a pivotal role in ensuring data quality and identifying missing or erroneous values. The guidance provides the techniques of how to check for missing values and empty fields in the dataset, emphasizing the importance of data quality for accurate analysis and visualization. This data analysis highlighted the versatility of these Python libraries for geospatial tasks, enabling users to handle geospatial data effectively from start to finish.