IPA 주관 인공지능센터 기본(fundamental) 과정

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In [1]:
```python
import geopandas as gpd
```

In [2]:
```python
%matplotlib inline
```

In [3]:
```python
world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))
```

In [4]:
```python
gpd.datasets.available
```

Out[4]: ['naturalearth_cities', 'naturalearth_lowres', 'nybb']

In [5]:
```python
world_cities = gpd.read_file(gpd.datasets.get_path('naturalearth_cities'))
```
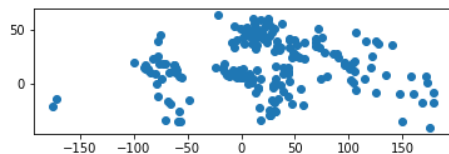
In [6]:
```python
world.head()
```

Out[6]:

|	pop_est	continent	name	iso_a3	gdp_md_est	geometry
0	920938	Oceania	Fiji	FJI	8374.0	(POLYGON ((180 -16.06713266364245, 180 -16.555...
1	53950935	Africa	Tanzania	TZA	150600.0	POLYGON ((33.90371119710453 -0.950000000000000...
2	603253	Africa	W. Sahara	ESH	906.5	POLYGON ((-8.665589565454809 27.65642588959236...
3	35623680	North America	Canada	CAN	1674000.0	(POLYGON ((-122.84 49.00000000000011, -122.974...
4	326625791	North America	United States of America	USA	18560000.0	(POLYGON ((-122.84 49.00000000000011, -120 49....

In [7]:
```python
world_cities.plot()
```

Out[7]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba8f7c6f60>

In [8]:
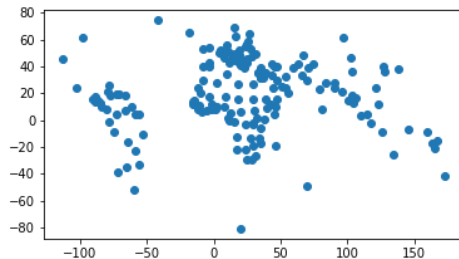```python
world.plot()
```

Out[8]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba89e9a1d0>
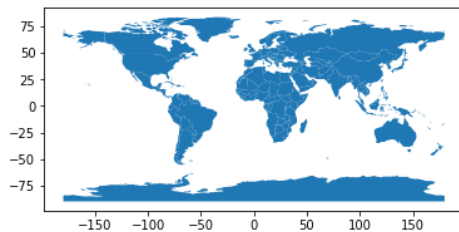


In [9]:
```python
world['centroid_column'] = world.centroid
world = world.set_geometry('centroid_column')
world.plot()
```

Out[9]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba89e14be0>

In [10]:
```python
world.geometry.name
```

Out[10]: 'centroid_column'

In [11]:
```python
import fiona
```

In [12]:
```python
fiona.supported_drivers
```

Out[12]: {'AeronavFAA': 'r',
'ARCGEN': 'r',
'BNA': 'raw',
'DXF': 'raw',
'CSV': 'raw',

```
          'OpenFileGDB': 'r',
          'ESRIJSON': 'r',
          'ESRI Shapefile': 'raw',
          'GeoJSON': 'rw',
          'GPKG': 'rw',
          'GML': 'raw',
          'GPX': 'raw',
          'GPSTrackMaker': 'raw',
          'Idrisi': 'r',
          'MapInfo File': 'raw',
          'DGN': 'raw',
          'S57': 'r',
          'SEGY': 'r',
          'SUA': 'r',
          'TopoJSON': 'r'}
```
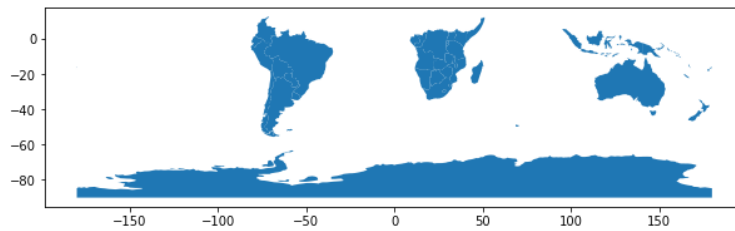
In [13]:
```python
world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))
southern_world = world.cx[:, :0]
southern_world.plot(figsize=(10, 3))
```

Out[13]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba89e70390>


In [14]: `world`

Out[14]:

	pop_est	continent	name	iso_a3	gdp_md_est	geometry
0	920938	Oceania	Fiji	FJI	8374.0	(POLYGON ((180 -16.06713266364245, 180 -16.555...
1	53950935	Africa	Tanzania	TZA	150600.0	POLYGON ((33.90371119710453 -0.950000000000000...
2	603253	Africa	W. Sahara	ESH	906.5	POLYGON ((-8.665589565454809 27.65642588959236...
3	35623680	North America	Canada	CAN	1674000.0	(POLYGON ((-122.84 49.00000000000011, -122.974...
4	326625791	North America	United States of America	USA	18560000.0	(POLYGON ((-122.84 49.00000000000011, -120 49....
5	18556698	Asia	Kazakhstan	KAZ	460700.0	POLYGON ((87.35997033076265 49.21498078062912,...
6	29748859	Asia	Uzbekistan	UZB	202300.0	POLYGON ((55.96819135928291 41.30864166926936,...
7	6909701	Oceania	Papua New Guinea	PNG	28020.0	(POLYGON ((141.0002104025918 -2.60015105551566...
8	260580739	Asia	Indonesia	IDN	3028000.0	(POLYGON ((141.0002104025918 -2.60015105551566...
9	44293293	South America	Argentina	ARG	879400.0	(POLYGON ((-68.63401022758323 -52.636370458874...
10	17789267	South America	Chile	CHL	436100.0	(POLYGON ((-68.63401022758323 -52.636370458874...
11	83301151	Africa	Dem. Rep. Congo	COD	66010.0	POLYGON ((29.33999759290035 -4.499983412294092...
12	7531386	Africa	Somalia	SOM	4719.0	POLYGON ((41.58513 -1.68325, 40.993 -0.85829, ...
13	47615739	Africa	Kenya	KEN	152700.0	POLYGON ((39.20222 -4.67677, 37.7669 -3.67712,...
14	37345935	Africa	Sudan	SDN	176300.0	POLYGON ((24.56736901215208 8.229187933785468,...
15	12075985	Africa	Chad	TCD	30590.0	POLYGON ((23.83766000000014 19.5804700000001, ...
16	10646714	North America	Haiti	HTI	19340.0	POLYGON ((-71.71236141629296 19.71445587816736...
17	10734247	North America	Dominican Rep.	DOM	161900.0	POLYGON ((-71.70830481635805 18.04499705654609...
18	142257519	Europe	Russia	RUS	3745000.0	(POLYGON ((178.7253 71.0988, 180.0000000000001...
19	329988	North America	Bahamas	BHS	9066.0	(POLYGON ((-78.98 26.79, -78.51000000000001 26...
20	2931	South America	Falkland Is.	FLK	281.8	POLYGON ((-61.2 -51.85, -60 -51.25, -59.15 -51...
21	5320045	Europe	Norway	-99	364700.0	(POLYGON ((15.14282 79.67431000000001, 15.5225...
22	57713	North America	Greenland	GRL	2173.0	POLYGON ((-46.76379 82.62796, -43.40644 83.225...
23	140	Seven seas (open ocean)	Fr. S. Antarctic Lands	ATF	16.0	POLYGON ((68.935 -48.62500000000001, 69.58 -48...
24	1291358	Asia	Timor-Leste	TLS	4975.0	POLYGON ((124.9686824891162 -8.892790215697083...
25	54841552	Africa	South Africa	ZAF	739100.0	POLYGON ((16.34497684089524 -28.5767050106977,...
26	1958042	Africa	Lesotho	LSO	6019.0	POLYGON ((28.97826256685724 -28.95559661226171...
27	124574795	North America	Mexico	MEX	2307000.0	POLYGON ((-117.1277599999999 32.53533999999996...
28	3360148	South America	Uruguay	URY	73250.0	POLYGON ((-57.62513342958296 -30.2162948544542...
29	207353391	South America	Brazil	BRA	3081000.0	POLYGON ((-53.37366166849824 -33.7683777809007...
...	...	...	...	...	...	...
147	104256076	Asia	Philippines	PHL	801900.0	(POLYGON ((120.8338961121466 12.70449616134243...
148	31381992	Asia	Malaysia	MYS	863000.0	(POLYGON ((100.0857568705271 6.464489447450291...
149	443593	Asia	Brunei	BRN	33730.0	POLYGON ((115.4507104838698 5.447729803891534,...
150	1972126	Europe	Slovenia	SVN	68350.0	POLYGON ((13.80647545742153 46.50930613869122,...
151	5491218	Europe	Finland	FIN	224137.0	POLYGON ((28.59192955904319 69.06477692328666,...
152	5445829	Europe	Slovakia	SVK	168800.0	POLYGON ((22.55813764821175 49.08573802346714,...
153	10674723	Europe	Czechia	CZE	350900.0	POLYGON ((15.01699588385867 51.10667409932158,...
154	5918919	Africa	Eritrea	ERI	9169.0	POLYGON ((36.42951000000005 14.42211000000003,...

|	pop_est	continent	name	iso_a3	gdp_md_est	geometry
155	126451398	Asia	Japan	JPN	4932000.0	(POLYGON ((141.884600864835 39.18086456965148...
156	6943739	South America	Paraguay	PRY	64670.0	POLYGON ((-58.16639238140804 -20.1767009416536...
157	28036829	Asia	Yemen	YEM	73450.0	POLYGON ((52.00000980002224 19.00000336351606,...
158	28571770	Asia	Saudi Arabia	SAU	1731000.0	POLYGON ((34.95603722508426 29.35655467377885,...
159	4050	Antarctica	Antarctica	ATA	810.0	(POLYGON ((-48.66061601418252 -78.047018731598...
160	265100	Asia	N. Cyprus	-99	3600.0	POLYGON ((32.73178022637745 35.14002594658844,...
161	1221549	Asia	Cyprus	CYP	29260.0	POLYGON ((32.73178022637745 35.14002594658844,...
162	33986655	Africa	Morocco	MAR	282800.0	POLYGON ((-2.169913702798624 35.16839630791668...
163	97041072	Africa	Egypt	EGY	1105000.0	POLYGON ((36.86622999999997 22, 32.89999999999...
164	6653210	Africa	Libya	LBY	90890.0	POLYGON ((25 22, 25.00000000000011 20.00304000...
165	105350020	Africa	Ethiopia	ETH	174700.0	POLYGON ((47.78942 8.003, 44.96360000000001 5....
166	865267	Africa	Djibouti	DJI	3345.0	POLYGON ((42.35156000000012 12.54223000000013,...
167	3500000	Africa	Somaliland	-99	12250.0	POLYGON ((48.94820475850985 11.41061728169797,...
168	39570125	Africa	Uganda	UGA	84930.0	POLYGON ((33.90371119710453 -0.950000000000000...
169	11901484	Africa	Rwanda	RWA	21970.0	POLYGON ((30.41910485201925 -1.134659112150416...
170	3856181	Europe	Bosnia and Herz.	BIH	42530.0	POLYGON ((18.55999999999995 42.64999999999998,...
171	2103721	Europe	Macedonia	MKD	29520.0	POLYGON ((22.38052575042459 42.32025950781509,...
172	7111024	Europe	Serbia	SRB	101800.0	POLYGON ((18.82982479287395 45.90887235802528,...
173	642550	Europe	Montenegro	MNE	10610.0	POLYGON ((20.07070000000004 42.58863000000008,...
174	1895250	Europe	Kosovo	-99	18490.0	POLYGON ((20.59024654668023 41.85540891928363,...
175	1218208	North America	Trinidad and Tobago	TTO	43570.0	POLYGON ((-61.68000000000001 10.76, -61.105 10...
176	13026129	Africa	S. Sudan	SSD	20880.0	POLYGON ((30.83385242171543 3.509171604222463,...

177 rows × 6 columns

```
In [15]: world = world.loc[(world.pop_est>0) & (world.continent!="Antarctica")]
         world['gdp_per_cap'] = world.gdp_md_est / world.pop_est
         world.plot(column='gdp_per_cap')
```

Out[15]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba89d28588>
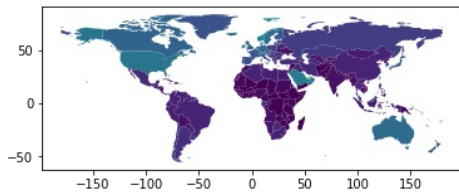

```
In [16]: world.plot(column='gdp_per_cap', cmap='OrRd', scheme='quantiles')
```
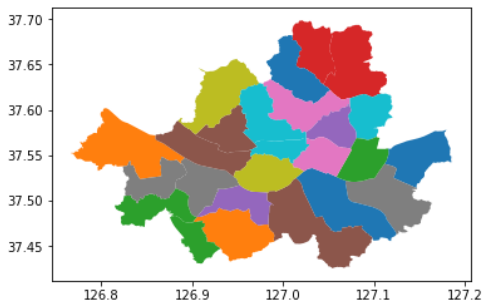
Out[16]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba839a5be0>
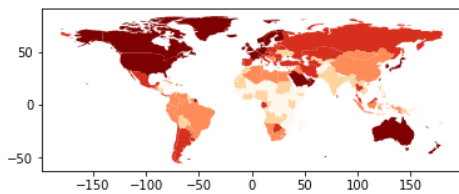

```
In [17]: seoul = gpd.read_file('asset/seoul_shp')
```

```
In [18]: seoul.plot(column='name')
```

Out[18]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba7b391908>


```
In [19]: seoul.head()
```

Out[19]:

|	code	name	name_eng	base_year	geometry
0	11250	강동구	Gangdong-gu	2013	POLYGON ((127.1151958498161 37.55753318070492,...
1	11240	송파구	Songpa-gu	2013	POLYGON ((127.0690698130372 37.52227942350503,...
2	11230	강남구	Gangnam-gu	2013	POLYGON ((127.058673592884 37.52629974922568, ...
3	11220	서초구	Seocho-gu	2013	POLYGON ((127.0139711966751 37.52503988289669...

code	name	name_eng	base_year	geometry
3	11220	서초구	Seocho-gu	2013	POLYGON ((127.013971196075137.32563988289669,...
4	11210	관악구	Gwanak-gu	2013	POLYGON ((126.96108989906183 37.49100376129394,...

In [20]:
```python
seoul['coords'] = seoul['geometry'].apply(lambda x: x.representative_point().coords[:])
seoul['coords'] = [coords[0] for coords in seoul['coords']]
```

In [21]:
```python
world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))
cities = gpd.read_file(gpd.datasets.get_path('naturalearth_cities'))


base = world.plot(color='white', edgecolor='black')

cities.plot(ax=base, marker='o', color='red', markersize=5);
```
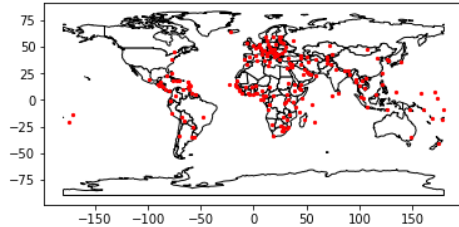

In [22]:
```python
import matplotlib.pyplot as plt
import matplotlib.font_manager as fm
```

In [23]:
```python
font_list = fm.findSystemFonts(fontpaths=None, fontext='ttf')
for font in font_list:
    print(font)
```

```
/usr/share/fonts/truetype/msttcorefonts/Georgia.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyrecursor-italic.otf
/usr/share/texmf/fonts/opentype/public/lm/lmsans12-oblique.otf
/usr/share/fonts/truetype/liberation/LiberationSerif-Regular.ttf
/usr/share/fonts/truetype/lato/Lato-Regular.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSerifCondensed.ttf
/usr/share/fonts/truetype/liberation/LiberationMono-Bold.ttf
/usr/share/fonts/truetype/msttcorefonts/Andale_Mono.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreheroscn-bold.otf
/usr/share/fonts/truetype/arphic-bkai00mp/bkai00mp.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSansCondensed-Oblique.ttf
/usr/share/fonts/truetype/nanum/NanumPen.ttf
/usr/share/fonts/truetype/msttcorefonts/Trebuchet_MS_Bold.ttf
/usr/share/fonts/korean/NanumMyeongjo.ttf
/usr/share/fonts/truetype/msttcorefonts/cour.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyrebonum-bold.otf
/usr/share/fonts/korean/NanumGothicLight.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmsans12-regular.otf
/usr/share/fonts/truetype/msttcorefonts/Times_New_Roman_Bold_Italic.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmsans8-oblique.otf
/usr/share/fonts/truetype/unfonts-core/UnGraphicBold.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmsans17-regular.otf
/usr/share/fonts/truetype/nanum/NanumSquareRoundB.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmsans17-oblique.otf
/usr/share/fonts/opentype/ipafont-mincho/ipamp.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmsansquot8-regular.otf
/usr/share/texmf/fonts/opentype/public/lm/lmmonoprop10-regular.otf
/usr/share/fonts/truetype/unfonts-core/UnPilgi.ttf
/usr/share/fonts/truetype/nanum/NanumSquareEB.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmsans10-regular.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyretermes-regular.otf
/usr/share/fonts/truetype/nanum/NanumGothic.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmono12-regular.otf
/usr/share/fonts/truetype/dejavu/DejaVuSansMono-Bold.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmono10-regular.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreschola-bold.otf
/usr/share/fonts/truetype/msttcorefonts/times.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmroman10-italic.otf
/usr/share/fonts/truetype/msttcorefonts/trebuc.ttf
/usr/share/fonts/truetype/msttcorefonts/Times_New_Roman_Italic.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmroman9-bold.otf
/usr/share/fonts/truetype/liberation/LiberationSansNarrow-Regular.ttf
/usr/share/fonts/korean/NanumBarunGothic.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreschola-regular.otf
/usr/share/texmf/fonts/opentype/public/lm/lmromanslant9-regular.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyrepagella-italic.otf
/usr/share/texmf/fonts/opentype/public/lm/lmsansdemicond10-regular.otf
/usr/share/fonts/truetype/lato/Lato-MediumItalic.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSansCondensed.ttf
/usr/share/fonts/korean/NanumSquareRoundEB.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmonolt10-regular.otf
/usr/share/fonts/truetype/lato/Lato-Light.ttf
/usr/share/fonts/korean/NanumBarunGothicBold.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmromandemi10-oblique.otf
/usr/share/fonts/truetype/msttcorefonts/trebucbd.ttf
/usr/share/fonts/truetype/liberation/LiberationSansNarrow-BoldItalic.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreheros-regular.otf
/usr/share/fonts/truetype/msttcorefonts/Arial_Bold.ttf
/usr/share/fonts/truetype/nanum/NanumBarunGothic.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSerif-Italic.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmroman7-bold.otf
/usr/share/fonts/truetype/msttcorefonts/courbd.ttf
/usr/share/fonts/truetype/liberation/LiberationSerif-BoldItalic.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSansMono-Oblique.ttf
```

```
/usr/share/texmf/fonts/opentype/public/lm/lmroman12-italic.otf
/usr/share/texmf/fonts/opentype/public/lm/lmroman8-italic.otf
/usr/share/texmf/fonts/opentype/public/lm/lmroman9-italic.otf
/usr/share/texmf/fonts/opentype/public/lm/lmroman12-bold.otf
/usr/share/fonts/truetype/arphic-gkai00mp/gkai00mp.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmroman5-bold.otf
/usr/share/fonts/truetype/lato/Lato-Medium.ttf
/usr/share/fonts/truetype/unfonts-core/UnDotumBold.ttf
/usr/share/fonts/truetype/nanum/NanumMyeongjoExtraBold.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSansMono-BoldOblique.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmonocaps10-regular.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreadventor-bold.otf
/usr/share/fonts/truetype/unfonts-core/UnGungseo.ttf
/usr/share/fonts/truetype/dejavu/DejaVuMathTeXGyre.ttf
/usr/share/fonts/truetype/lato/Lato-HairlineItalic.ttf
/usr/share/fonts/truetype/nanum/NanumBarunpenR.ttf
/usr/share/fonts/truetype/nanum/NanumBarunGothicBold.ttf
/usr/share/fonts/truetype/unfonts-core/UnPilgiBold.ttf
/usr/share/fonts/truetype/nanum/NanumSquareL.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmromancaps10-regular.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreheroscn-bolditalic.otf
/usr/share/fonts/truetype/liberation/LiberationSans-Regular.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmroman12-regular.otf
/usr/share/fonts/truetype/nanum/NanumMyeongjoEco.ttf
/usr/share/fonts/truetype/msttcorefonts/timesi.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyrebonum-bolditalic.otf
/usr/share/texmf/fonts/opentype/public/lm/lmroman6-regular.otf
/usr/share/fonts/truetype/msttcorefonts/timesbd.ttf
/usr/share/fonts/truetype/nanum/NanumBarunGothicUltraLight.ttf
/usr/share/fonts/korean/NanumGothic.ttf
/usr/share/fonts/korean/NanumPen.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyrecursor-bold.otf
/usr/share/fonts/truetype/msttcorefonts/verdanaz.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmsansquot8-boldoblique.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre-math/texgyreschola-math.otf
/usr/share/texmf/fonts/opentype/public/lm/lmsans10-boldoblique.otf
/usr/share/fonts/truetype/fonts-japanese-mincho.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSans-Bold.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmromanunsl10-regular.otf
/usr/share/fonts/opentype/ipaexfont-mincho/ipaexm.ttf
/usr/share/fonts/korean/NanumSquareB.ttf
/usr/share/fonts/truetype/msttcorefonts/courbi.ttf
/usr/share/fonts/korean/NanumBarunpenB.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmonoltcond10-oblique.otf
/usr/share/texmf/fonts/opentype/public/lm/lmmonoltcond10-regular.otf
/usr/share/texmf/fonts/opentype/public/lm/lmromandunh10-oblique.otf
/usr/share/fonts/truetype/nanum/NanumMyeongjoEcoExtraBold.ttf
/usr/share/fonts/truetype/nanum/NanumMyeongjoEcoBold.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmono10-italic.otf
/usr/share/texmf/fonts/opentype/public/lm/lmroman6-bold.otf
/usr/share/texmf/fonts/opentype/public/lm/lmmonoproplt10-boldoblique.otf
/usr/share/fonts/truetype/unfonts-extra/UnShinmun.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSansCondensed-Bold.ttf
/usr/share/fonts/truetype/lato/Lato-Bold.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreheros-bolditalic.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyrechorus-mediumitalic.otf
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/usr/share/fonts/truetype/msttcorefonts/Georgia_Bold.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreheros-bold.otf
/usr/share/fonts/truetype/nanum/NanumSquareRoundL.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmsansquot8-bold.otf
/usr/share/fonts/truetype/dejavu/DejaVuSans-Oblique.ttf
/usr/share/fonts/korean/NanumSquareRoundR.ttf
/usr/share/fonts/truetype/noto/NotoMono-Regular.ttf
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/usr/share/fonts/truetype/msttcorefonts/webdings.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmonoslant10-regular.otf
/usr/share/fonts/korean/NanumGothicBold.ttf
/usr/share/fonts/truetype/nanum/NanumSquareRoundEB.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSerifCondensed-Bold.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmroman10-bolditalic.otf
/usr/share/fonts/korean/NanumBarunGothicLight.ttf
/usr/share/fonts/truetype/padauk/Padauk-Bold.ttf
/usr/share/fonts/truetype/msttcorefonts/georgia.ttf
/usr/share/fonts/truetype/msttcorefonts/Times_New_Roman.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSerifCondensed-Italic.ttf
/usr/share/fonts/truetype/nanum/NanumGothicCoding.ttf
/usr/share/fonts/truetype/unfonts-core/UnGraphic.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmroman5-regular.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre-math/texgyrepagella-math.otf
/usr/share/fonts/truetype/msttcorefonts/arialbi.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmonoproplt10-bold.otf
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/usr/share/fonts/truetype/liberation/LiberationMono-Italic.ttf
/usr/share/fonts/opentype/ipafont-mincho/ipam.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSerif-BoldItalic.ttf
/usr/share/fonts/truetype/msttcorefonts/Comic_Sans_MS_Bold.ttf
/usr/share/fonts/truetype/padauk/PadaukBook-Bold.ttf
/usr/share/fonts/truetype/msttcorefonts/Arial_Italic.ttf
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/usr/share/texmf/fonts/opentype/public/lm/lmsansquot8-oblique.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre-math/texgyretermes-math.otf
/usr/share/texmf/fonts/opentype/public/lm/lmromanslant10-regular.otf
```

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/usr/share/fonts/truetype/dejavu/DejaVuSans-ExtraLight.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmono8-regular.otf
/usr/share/fonts/truetype/nanum/NanumGothicEcoBold.ttf
/usr/share/fonts/truetype/lato/Lato-BlackItalic.ttf
/usr/share/fonts/truetype/unfonts-extra/UnJamoDotum.ttf
/usr/share/fonts/truetype/lato/Lato-Semibold.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmromandemi10-regular.otf
/usr/share/texmf/fonts/opentype/public/lm/lmroman8-bold.otf
/usr/share/fonts/truetype/unfonts-extra/UnYetgul.ttf
/usr/share/fonts/truetype/nanum/NanumGothicExtraBold.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSansCondensed-BoldOblique.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreschola-italic.otf
/usr/share/fonts/truetype/msttcorefonts/Webdings.ttf
/usr/share/fonts/truetype/liberation/LiberationSansNarrow-Bold.ttf
/usr/share/fonts/korean/NanumSquareR.ttf
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/usr/share/fonts/truetype/dejavu/DejaVuSerif-Bold.ttf
/usr/share/fonts/truetype/nanum/NanumMyeongjo.ttf
/usr/share/fonts/truetype/padauk/Padauk-Regular.ttf
/usr/share/fonts/truetype/msttcorefonts/ariali.ttf
/usr/share/fonts/truetype/msttcorefonts/andalemo.ttf
/usr/share/fonts/truetype/msttcorefonts/Courier_New.ttf
/usr/share/fonts/truetype/msttcorefonts/impact.ttf
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/usr/share/fonts/truetype/fonts-japanese-gothic.ttf
/usr/share/fonts/truetype/msttcorefonts/Arial.ttf
/usr/share/fonts/truetype/msttcorefonts/Trebuchet_MS.ttf
/usr/share/fonts/truetype/lato/Lato-Heavy.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmsans8-regular.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyrecursor-regular.otf
/usr/share/fonts/truetype/unfonts-extra/UnJamoBatang.ttf
/usr/share/fonts/truetype/msttcorefonts/comicbd.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmromandunh10-regular.otf
/usr/share/texmf/fonts/opentype/public/lm/lmmonolt10-oblique.otf
/usr/share/fonts/truetype/msttcorefonts/georgiab.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyrepagella-bold.otf
/usr/share/fonts/truetype/msttcorefonts/comic.ttf
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/usr/share/fonts/truetype/nanum/NanumSquareR.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmroman10-bold.otf
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/usr/share/fonts/truetype/msttcorefonts/couri.ttf
/usr/share/fonts/truetype/droid/DroidSansFallbackFull.ttf
/usr/share/fonts/opentype/ipaexfont-gothic/ipaexg.ttf
/usr/share/fonts/korean/NanumMyeongjoExtraBold.ttf
/usr/share/fonts/truetype/nanum/NanumGothicEco.ttf
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/usr/share/fonts/truetype/msttcorefonts/arialbd.ttf
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/usr/share/texmf/fonts/opentype/public/lm/lmsansdemicond10-oblique.otf
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/usr/share/fonts/truetype/baekmuk/dotum.ttf
/usr/share/fonts/truetype/msttcorefonts/Impact.ttf
/usr/share/fonts/truetype/unfonts-extra/UnPenheulim.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmsans10-oblique.otf
/usr/share/fonts/truetype/baekmuk/hline.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmroman7-italic.otf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreadventor-regular.otf
/usr/share/fonts/truetype/msttcorefonts/trebucit.ttf
/usr/share/fonts/truetype/msttcorefonts/arial.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmromanslant10-bold.otf
/usr/share/fonts/truetype/liberation/LiberationMono-BoldItalic.ttf
/usr/share/fonts/truetype/nanum/NanumBrush.ttf
/usr/share/fonts/korean/NanumBarunpenR.ttf
/usr/share/fonts/truetype/lato/Lato-Thin.ttf
/usr/share/fonts/truetype/nanum/NanumGothicBold.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmonolt10-boldoblique.otf
/usr/share/fonts/truetype/msttcorefonts/Verdana_Bold_Italic.ttf
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/usr/share/fonts/truetype/msttcorefonts/timesbi.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmroman7-regular.otf
/usr/share/fonts/opentype/ipafont-gothic/ipag.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreheroscn-regular.otf
/usr/share/fonts/korean/NanumSquareRoundL.ttf
/usr/share/fonts/truetype/msttcorefonts/Courier_New_Italic.ttf
/usr/share/fonts/truetype/baekmuk/batang.ttf
```

```
/usr/share/fonts/truetype/unfonts-extra/UnJamoNovel.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre-math/texgyrebonum-math.otf
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/usr/share/fonts/truetype/msttcorefonts/verdanai.ttf
/usr/share/fonts/truetype/liberation/LiberationSans-BoldItalic.ttf
/usr/share/fonts/truetype/msttcorefonts/trebucbi.ttf
/usr/share/fonts/truetype/unfonts-extra/UnPen.ttf
/usr/share/fonts/truetype/nanum/NanumBarunpenB.ttf
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/usr/share/fonts/opentype/ipafont-gothic/ipagp.ttf
/usr/share/fonts/korean/NanumBarunGothicUltraLight.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyretermes-bolditalic.otf
/usr/share/fonts/korean/NanumBrush.ttf
/usr/share/fonts/truetype/arphic-bsmi00lp/bsmi00lp.ttf
/usr/share/texmf/fonts/opentype/public/lm/lmmonolt10-bold.otf
/usr/share/fonts/truetype/dejavu/DejaVuSerifCondensed-BoldItalic.ttf
/usr/share/fonts/truetype/unfonts-extra/UnVada.ttf
/usr/share/fonts/truetype/unfonts-extra/UnTaza.ttf
/usr/share/fonts/truetype/msttcorefonts/Georgia_Italic.ttf
/usr/share/fonts/truetype/unfonts-core/UnDinaruLight.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSans.ttf
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/usr/share/fonts/truetype/msttcorefonts/Courier_New_Bold_Italic.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyretermes-italic.otf
/usr/share/fonts/truetype/msttcorefonts/georgiai.ttf
/usr/share/fonts/truetype/liberation/LiberationSans-Italic.ttf
/usr/share/fonts/truetype/unfonts-core/UnBatang.ttf
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/usr/share/texmf/fonts/opentype/public/lm-math/latinmodern-math.otf
/usr/share/fonts/truetype/arphic-gbsn00lp/gbsn00lp.ttf
/usr/share/fonts/truetype/lato/Lato-Black.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyreheros-italic.otf
/usr/share/texmf/fonts/opentype/public/lm/lmmonoprop10-oblique.otf
/usr/share/texmf/fonts/opentype/public/lm/lmroman10-regular.otf
/usr/share/texmf/fonts/opentype/public/lm/lmsans9-regular.otf
/usr/share/fonts/truetype/msttcorefonts/Verdana.ttf
/usr/share/fonts/truetype/baekmuk/gulim.ttf
/usr/share/fonts/truetype/msttcorefonts/Georgia_Bold_Italic.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyrepagella-bolditalic.otf
/usr/share/fonts/truetype/nanum/NanumMyeongjoBold.ttf
/usr/share/fonts/truetype/unfonts-core/UnDinaru.ttf
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/usr/share/fonts/truetype/liberation/LiberationSerif-Italic.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyrebonum-italic.otf
/usr/share/texmf/fonts/opentype/public/lm/lmmonoproplt10-oblique.otf
/usr/share/texmf/fonts/opentype/public/lm/lmromanslant17-regular.otf
/usr/share/texmf/fonts/opentype/public/lm/lmroman17-regular.otf
/usr/share/fonts/truetype/lato/Lato-Hairline.ttf
/usr/share/fonts/truetype/nanum/NanumGothicLight.ttf
/usr/share/fonts/korean/NanumSquareEB.ttf
/usr/share/fonts/truetype/unfonts-core/UnBatangBold.ttf
/usr/share/fonts/truetype/dejavu/DejaVuSerif.ttf
/usr/share/fonts/truetype/lato/Lato-LightItalic.ttf
/usr/share/fonts/truetype/nanum/NanumGothicEcoExtraBold.ttf
/usr/share/fonts/truetype/msttcorefonts/Times_New_Roman_Bold.ttf
/usr/share/fonts/truetype/msttcorefonts/Comic_Sans_MS.ttf
/usr/share/texmf/fonts/opentype/public/tex-gyre/texgyretermes-bold.otf
```
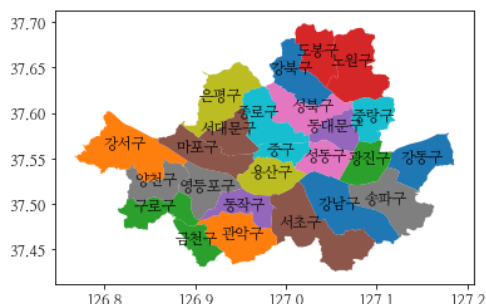
In [24]:
```python
plt.rcParams["font.family"] = 'NanumMyeongjo'
plt.rcParams["font.size"] = 12
plt.rcParams["figure.figsize"] = (14,4)
```

In [25]:
```python
seoul.plot(column='name')
for idx, row in seoul.iterrows():
    plt.annotate(s=row['name'], xy=row['coords'],
                 horizontalalignment='center')
```


In [26]:
```python
import matplotlib.pyplot as plt
```

In [27]:
```python
import matplotlib.pyplot as plt
fig, ax = plt.subplots()
seoul.plot(ax= ax, column='name')
```
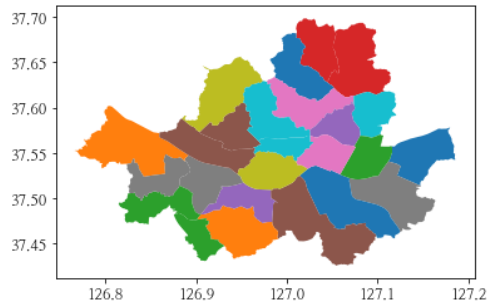
Out[27]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba7ab08c88>
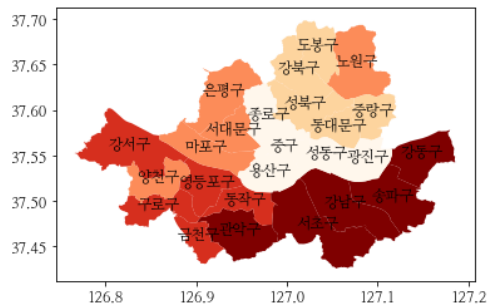
```
In [28]: seoul_x = seoul.centroid.apply(lambda p: p.x)
         seoul_y = seoul.centroid.apply(lambda p: p.y)
```

```
In [29]: len(seoul_x)
```

```
Out[29]: 25
```

```
In [30]: seoulcen = seoul.copy()
         seoulcen['geometry'] = seoul.geometry.centroid
```

```
In [31]: seoul.plot(column='code', cmap='OrRd', scheme='quantiles')
         for idx, row in seoulcen.iterrows():
             plt.annotate(s=row['name'], xy=[row['geometry'].x,row['geometry'].y],
                          horizontalalignment='center')
```



```
In [32]: for name, centroid in zip(seoul.name, seoul.centroid):
             print(name)
             # plt.text(centroid, name, fontsize=12)
```

강동구
송파구
강남구
서초구
관악구
동작구
영등포구
금천구
구로구
강서구
양천구
마포구
서대문구
은평구
노원구
도봉구
강북구
성북구
중랑구
동대문구
광진구
성동구
용산구
중구
종로구

```
In [33]: world.head()
```

Out[33]:

	pop_est	continent	name	iso_a3	gdp_md_est	geometry
0	920938	Oceania	Fiji	FJI	8374.0	(POLYGON ((180 -16.06713266364245, 180 -16.555...
1	53950935	Africa	Tanzania	TZA	150600.0	POLYGON ((33.90371119710453 -0.950000000000000...
2	603253	Africa	W. Sahara	ESH	906.5	POLYGON ((-8.665589565454809 27.65642588959236...
3	35623680	North America	Canada	CAN	1674000.0	(POLYGON ((-122.84 49.00000000000011, -122.974...
4	326625791	North America	United States of America	USA	18560000.0	(POLYGON ((-122.84 49.00000000000011, -120 49....

```
In [34]: world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))

         # Check original projection
         # (it's Platte Carre! x-y are long and lat)
         world.crs
```
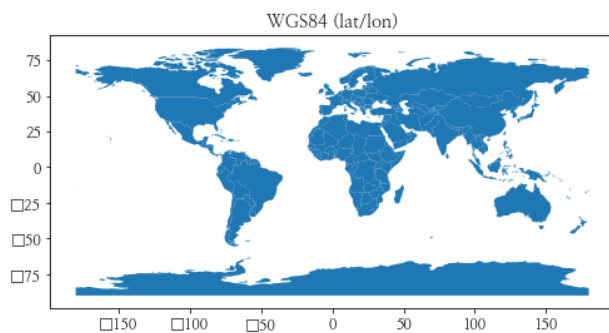
Out[34]: {'init': 'epsg:4326'}

```
In [35]:  # Visualize
          ax = world.plot()

          ax.set_title("WGS84 (lat/lon)")

Out[35]:  Text(0.5, 1.0, 'WGS84 (lat/lon)')
```
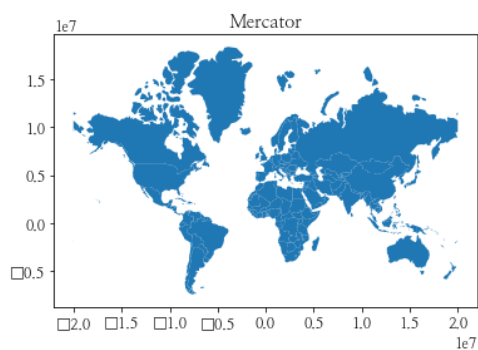


```
In [36]:  # Reproject to Mercator (after dropping Antartica)
          world = world[(world.name != "Antarctica") & (world.name != "Fr. S. Antarctic Lands")]

          world = world.to_crs({'init': 'epsg:3395'}) # world.to_crs(epsg=3395) would also work

          ax = world.plot()

          ax.set_title("Mercator");
```
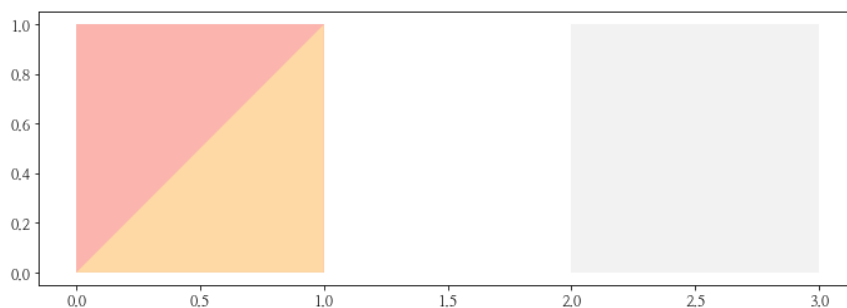


```
In [37]:  from shapely.geometry import Polygon

          p1 = Polygon([(0, 0), (1, 0), (1, 1), (0, 1)])
          p2 = Polygon([(0, 0), (1, 0), (1, 1)])
          p3 = Polygon([(2, 0), (3, 0), (3, 1), (2, 1)])

          g = gpd.GeoSeries([p1, p2, p3])
          g.plot(cmap='Pastel1')

Out[37]:  <matplotlib.axes._subplots.AxesSubplot at 0x7fba8dd6f2b0>
```



```
In [38]:  g.buffer(0.5).plot(cmap='Pastel1')

Out[38]:  <matplotlib.axes._subplots.AxesSubplot at 0x7fba7ac44860>
```
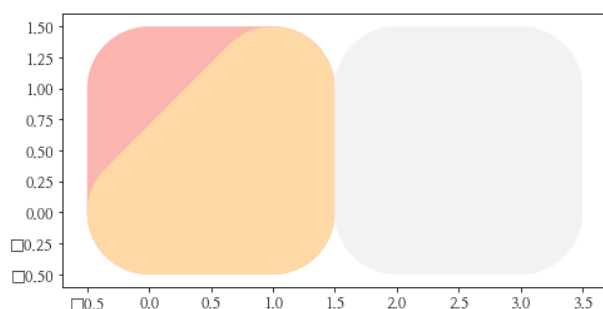
```
In [39]: nybb_path = gpd.datasets.get_path('nybb')
         boros = gpd.GeoDataFrame.from_file(nybb_path)
         boros.set_index('BoroCode', inplace=True)
         boros = boros.sort_index()
         boros
```

Out[39]:

BoroCode	BoroName	Shape_Leng	Shape_Area	geometry
1	Manhattan	359299.096471	6.364715e+08	(POLYGON ((981219.0557861328 188655.3157958984...
2	Bronx	464392.991824	1.186925e+09	(POLYGON ((1012821.805786133 229228.2645874023...
3	Brooklyn	741080.523166	1.937479e+09	(POLYGON ((1021176.479003906 151374.7969970703...
4	Queens	896344.047763	3.045213e+09	(POLYGON ((1029606.076599121 156073.8142089844...
5	Staten Island	330470.010332	1.623820e+09	(POLYGON ((970217.0223999023 145643.3322143555...

```
In [40]: boros.plot(cmap='Pastel1')
```

Out[40]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba8dc5a0b8>
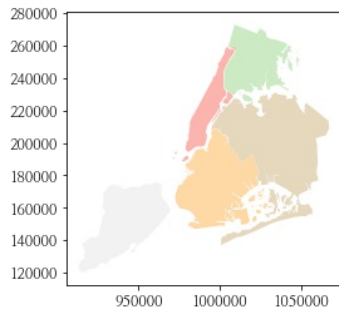

```
In [41]: from shapely.geometry import Point
         import numpy as np

         xmin, xmax, ymin, ymax = 900000, 1080000, 120000, 280000

         xc = (xmax - xmin) * np.random.random(2000) + xmin

         yc = (ymax - ymin) * np.random.random(2000) + ymin

         pts = gpd.GeoSeries([Point(x, y) for x, y in zip(xc, yc)])
```
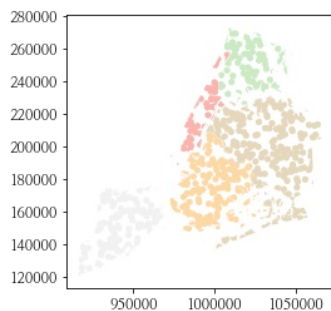
```
In [42]: circles = pts.buffer(2000)
```

```
In [43]: mp = circles.unary_union
```

```
In [44]: holes = boros['geometry'].intersection(mp)
```

```
In [45]: holes.plot(cmap='Pastel1')
```

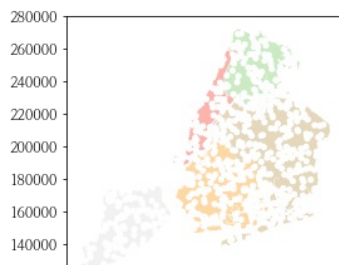Out[45]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba8d9bf908>


```
In [46]: circles = pts.buffer(2000) # 2000 안에 있는 Points만 남김

         mp = circles.unary_union # circles를 하나로 합침

         boros_with_holes = boros['geometry'].difference(mp)

         boros_with_holes.plot(cmap='Pastel1')
```
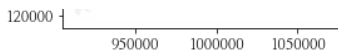
Out[46]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba8d9b9860>

```
120000
        950000    1000000    1050000
```

In [47]:
```python
world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))
world = world[['continent', 'geometry']]
continents = world.dissolve(by='continent')
continents.head()
```
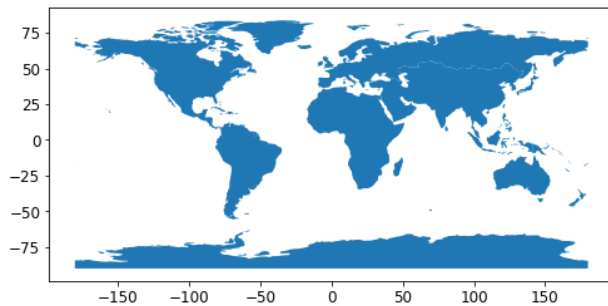
Out[47]:

continent	geometry
Africa	(POLYGON ((49.54351891459575 -12.4698328589405...
Antarctica	(POLYGON ((-163.7128956777287 -78.595667413241...
Asia	(POLYGON ((120.2950142762069 -10.2586499976035...
Europe	(POLYGON ((-51.65779741067889 4.15623240805302...
North America	(POLYGON ((-61.68000000000001 10.76, -61.105 1...

In [48]:
```python
plt.rcParams["font.family"] = 'DejaVu Sans'
```

In [49]:
```python
continents.plot()
```

Out[49]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba8de5d940>

In [50]:
```python
world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))
world = world[['continent', 'geometry', 'pop_est']]
continents = world.dissolve(by='continent', aggfunc='sum')
continents.head()
```

Out[50]:

continent	geometry	pop_est
Africa	(POLYGON ((49.54351891459575 -12.4698328589405...	1219176238
Antarctica	(POLYGON ((-163.7128956777287 -78.595667413241...	4050
Asia	(POLYGON ((120.2950142762069 -10.2586499976035...	4389144868
Europe	(POLYGON ((-51.65779741067889 4.15623240805302...	746398461
North America	(POLYGON ((-61.68000000000001 10.76, -61.105 1...	573042112

In [51]:
```python
continents.plot(column = 'pop_est', scheme='quantiles', cmap='YlOrRd')
```