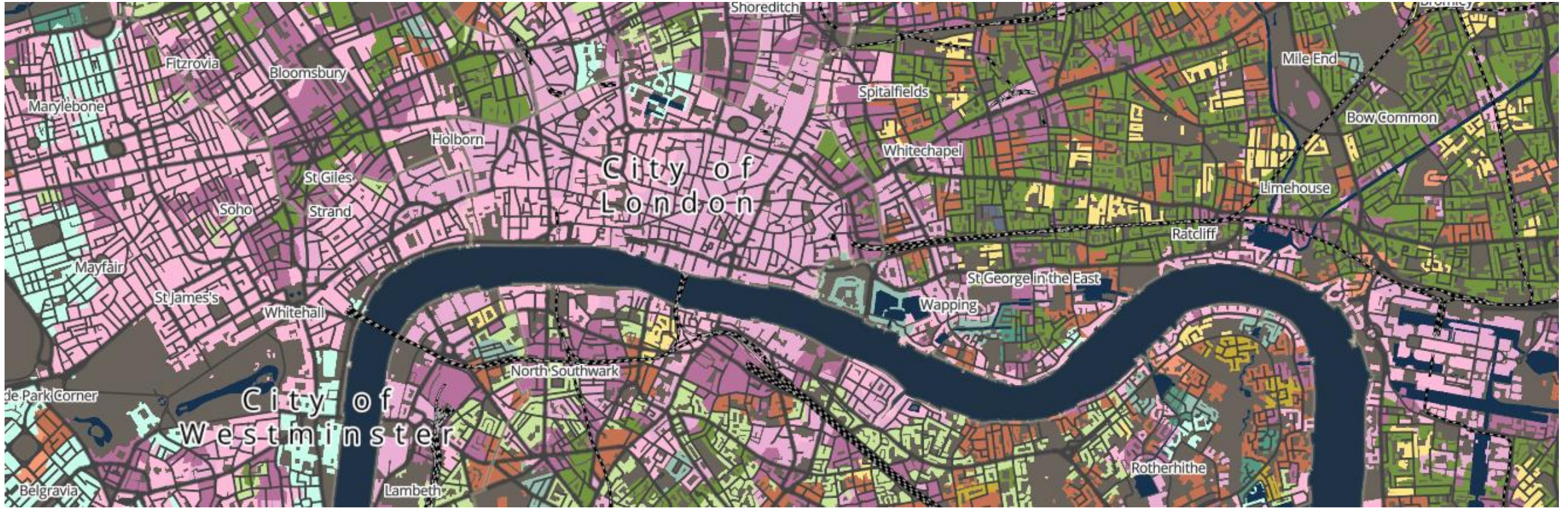# Geocomputation
Spatial Queries and Geometric Operations

This week

- Spatial properties

- Spatial operations

- Spatial relationships
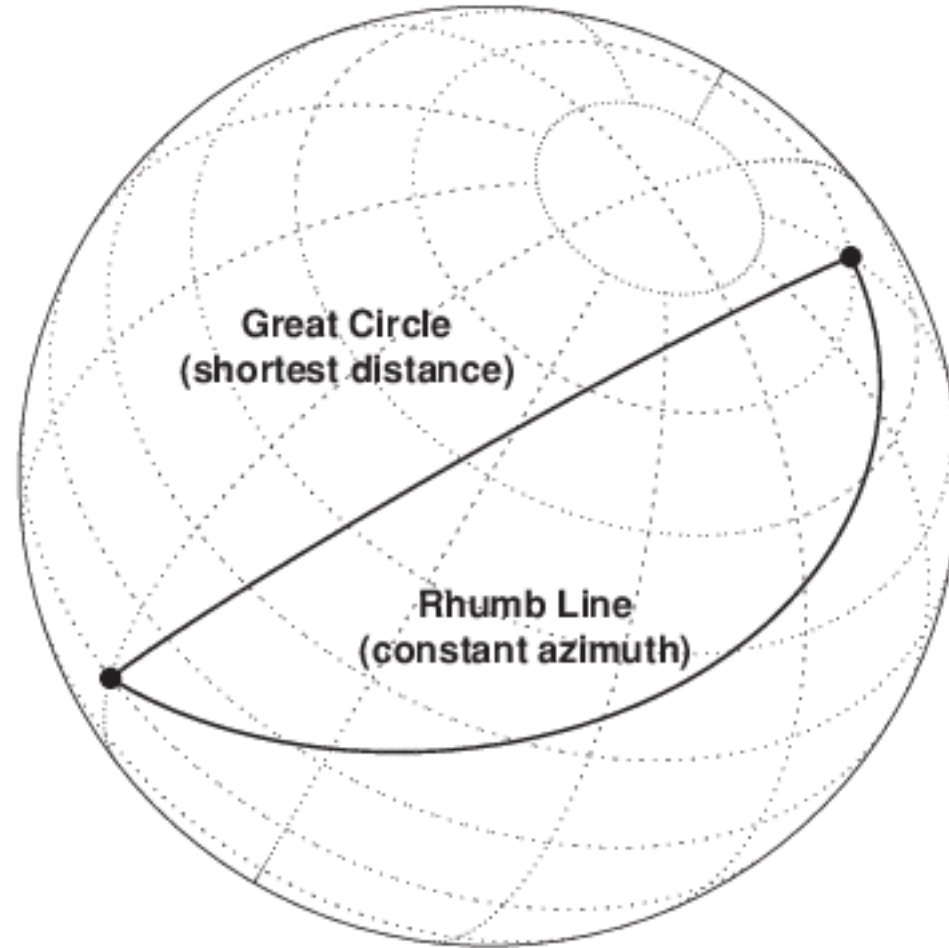
Spatial properties

- Much of spatial data involves the execution of <mark>spatial maths</mark> on spatial properties.

- We typically work with *"things"* like distance, area, and shape.

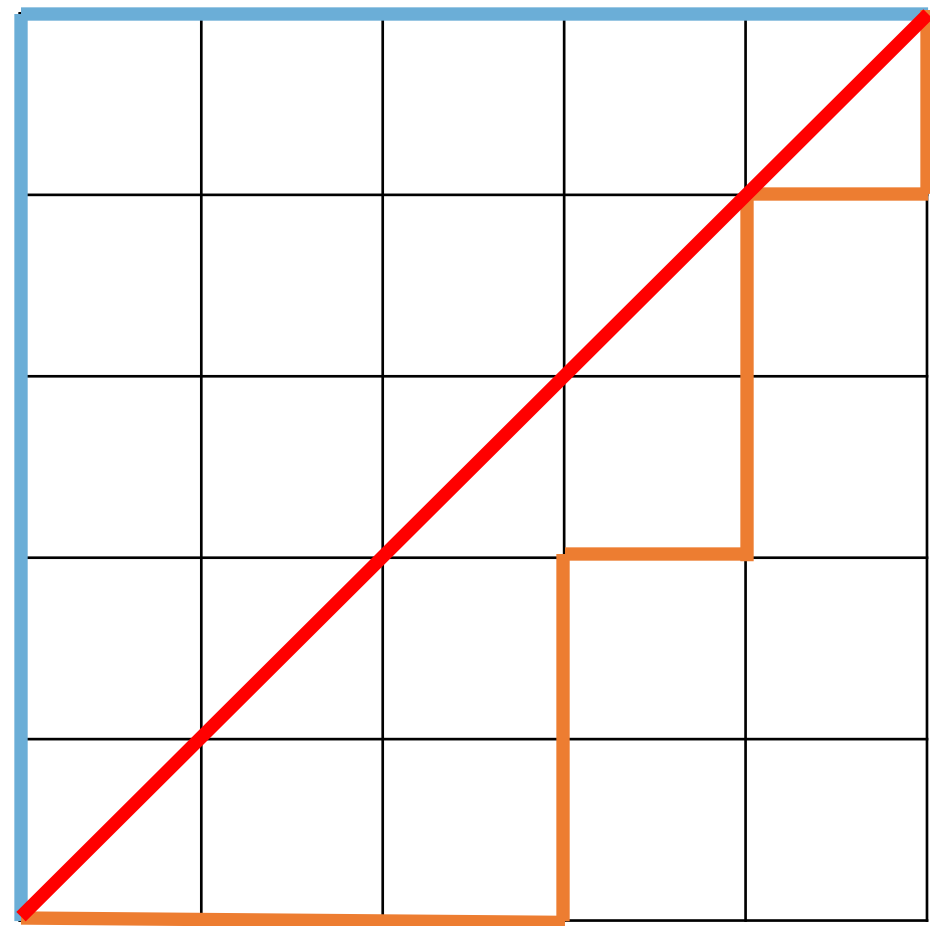- Different ways to think about these properties and how to conceptualise them.

Distance

Distance

Great Circle
(shortest distance)

Rhumb Line
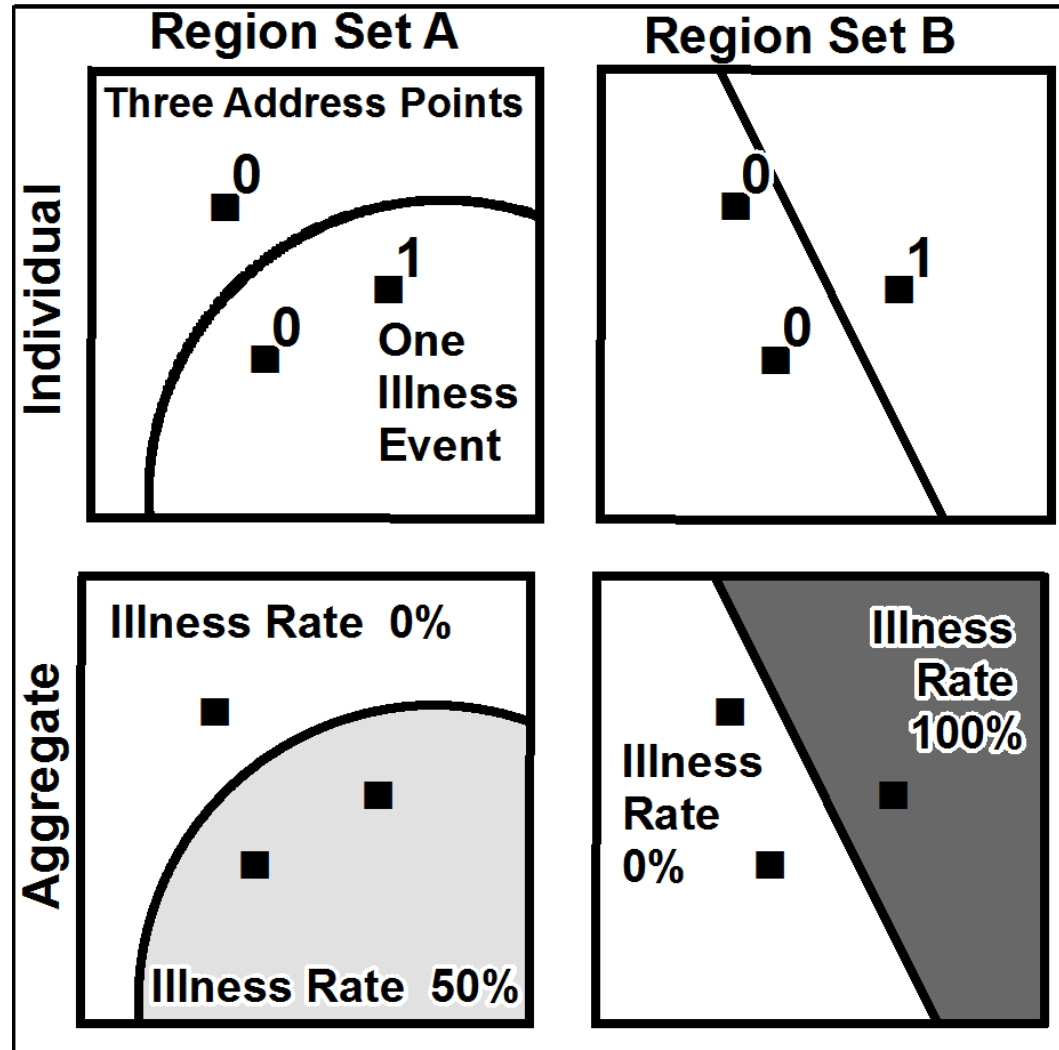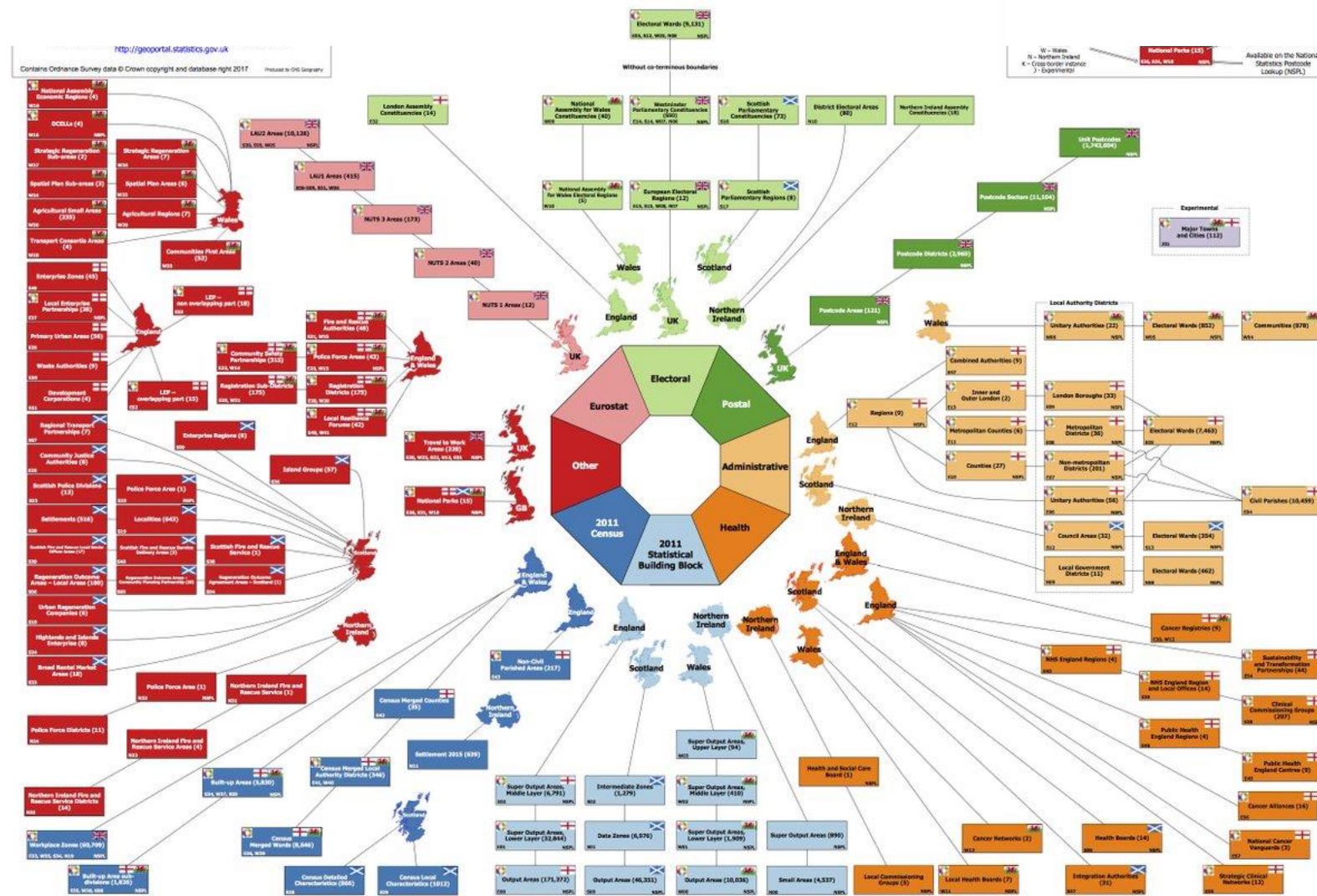(constant azimuth)
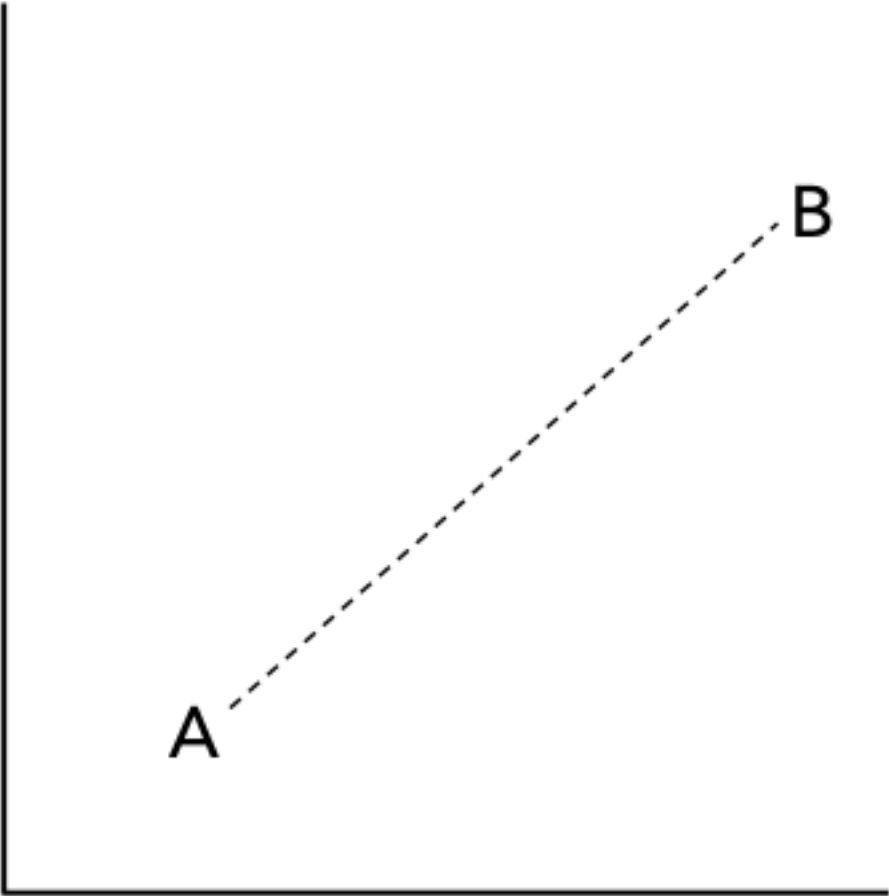
Distance

Area

Area

- Precision of the data source will affect calculations (e.g. simplified topology).
- Decision of which geography to use is crucial and depends on what you want to investigate – and keep the Modifiable Areal Unit Problem in mind.

# Modifiable Areal Unit Problem

Administrative Geographies
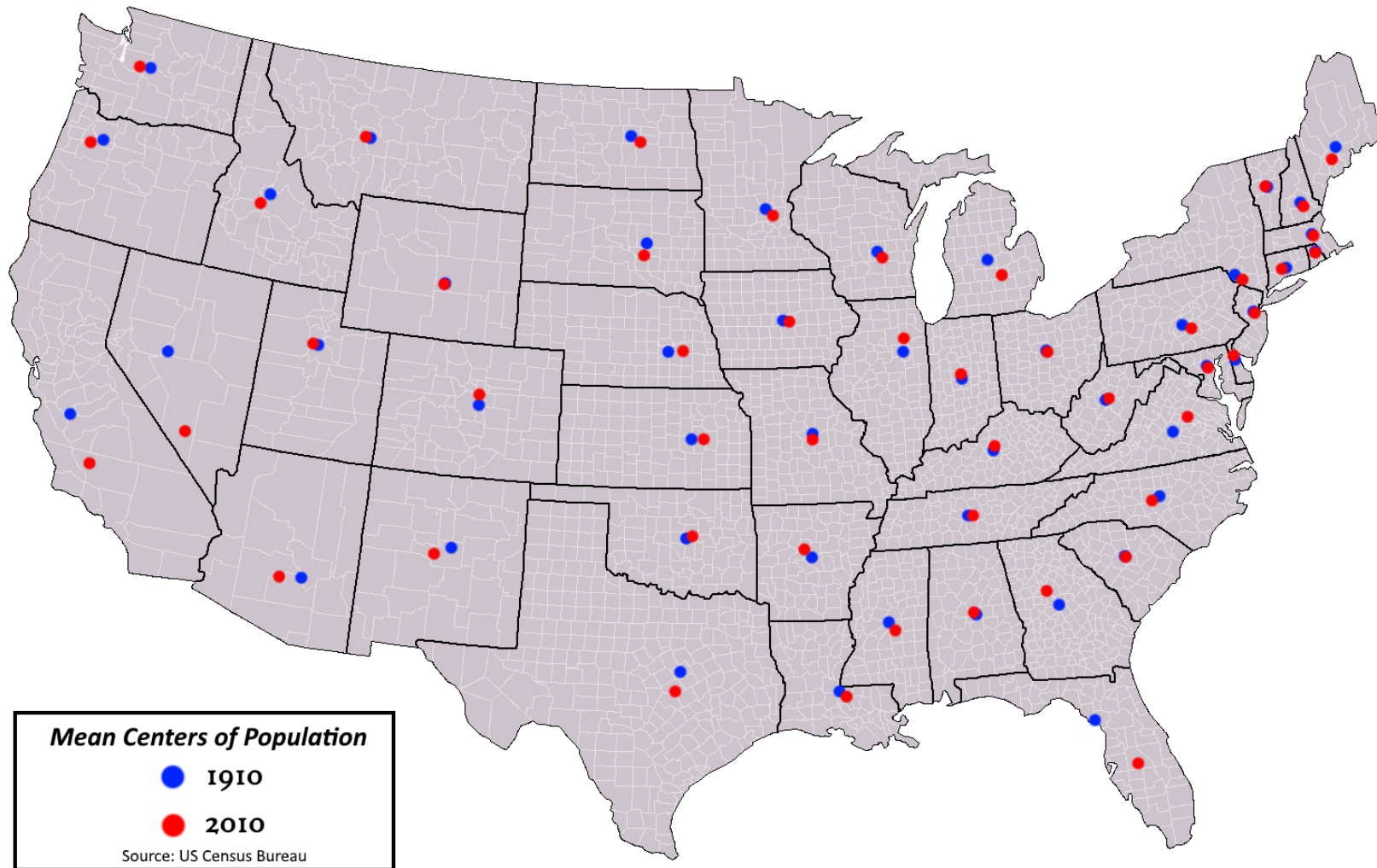
Shape

- Identify and characterise a shape, e.g. following a process of spatially clustering individual objects or geometries.

- Quantifiable with a compactness ratio or perimeter/area ratio.

- Shape can be important to consider when calculating geometric centroids.

Shape

centroid

what we need

Shape

Mean Centers of Population

🔵 1910

🔴 2010

Source: US Census Bureau
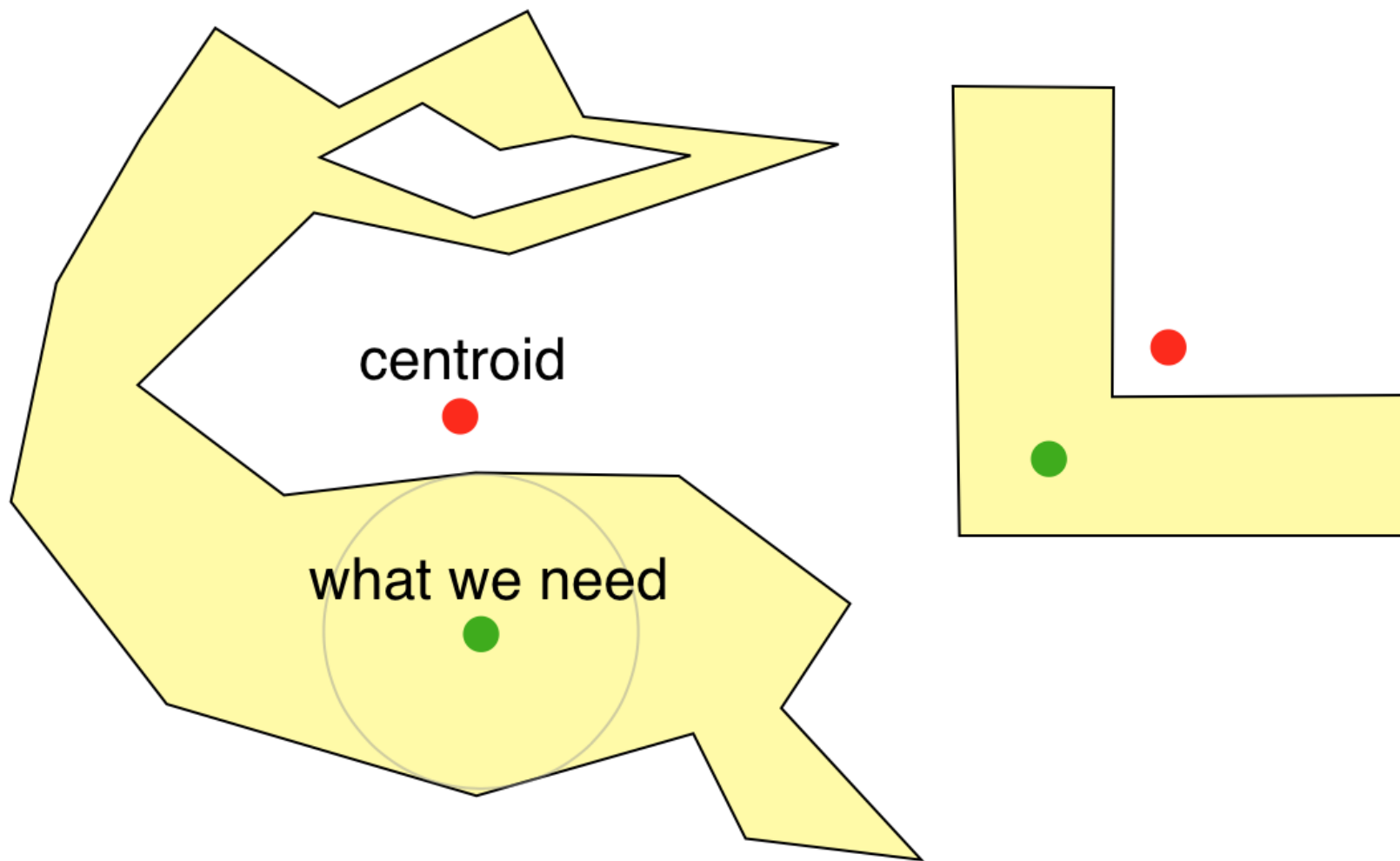
Spatial operations

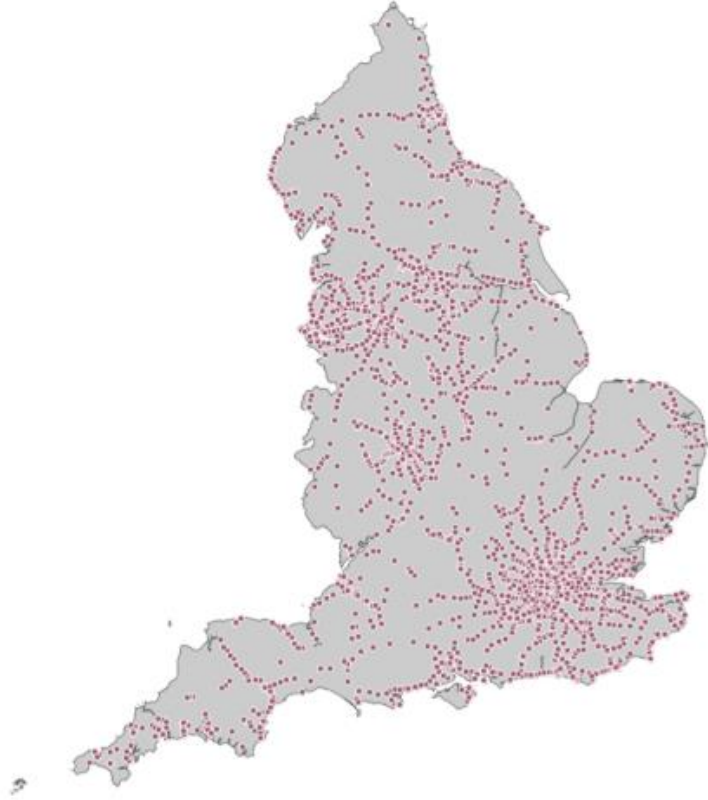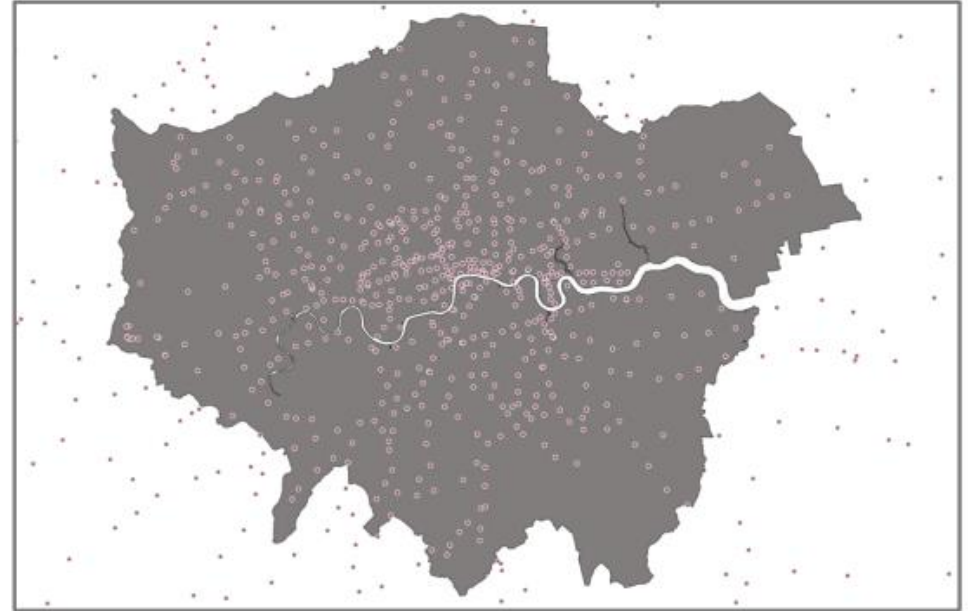-   Building blocks of spatial data analysis: selecting, filtering, reducing, and merging different geometries.

-   Using spatial properties like distance, area, and shape.

Spatial operations

Spatial operations

Use of spatial relationships to take data as an input, "do something" with the data and then produce output data that is a derivative of the analysis performed on the input data.

Spatial operations

Use of spatial relationships to take data as an input, "do something" with the data and then produce output data that is a derivative of the analysis performed on the input data.

Spatial relationships

- Spatial relationships define how exteriors, interiors, and boundaries of different geometries interact with one another.

- Known as topological relationship.

- Evaluates adjacency, connectivity, and / or containment.

Spatial relationships

Equals A is the same as B	(A B)
Touches A touches B	A, B touching
Overlaps A and B have multiple points in common	A, B overlapping
Contains A contains B	A(B)
Disjoint A shares nothing with B	A, B separate
Covers A covers B (or vice versa)	A(B)
Crosses A and B have at least one point in common	A B crossing lines

Spatial relationships

- There is some spatial mathematics behind calculating the topological relationships between spatial objects.

- *"Does polygon A overlap with Polygon B?"*

  1 Establish exterior, interior and boundaries of the geometries of each the object.

  2 Calculate the number of times these three properties intersect with one another.

  3 Follow the requirements of the function to understand if it is TRUE or FALSE.

Spatial analysis
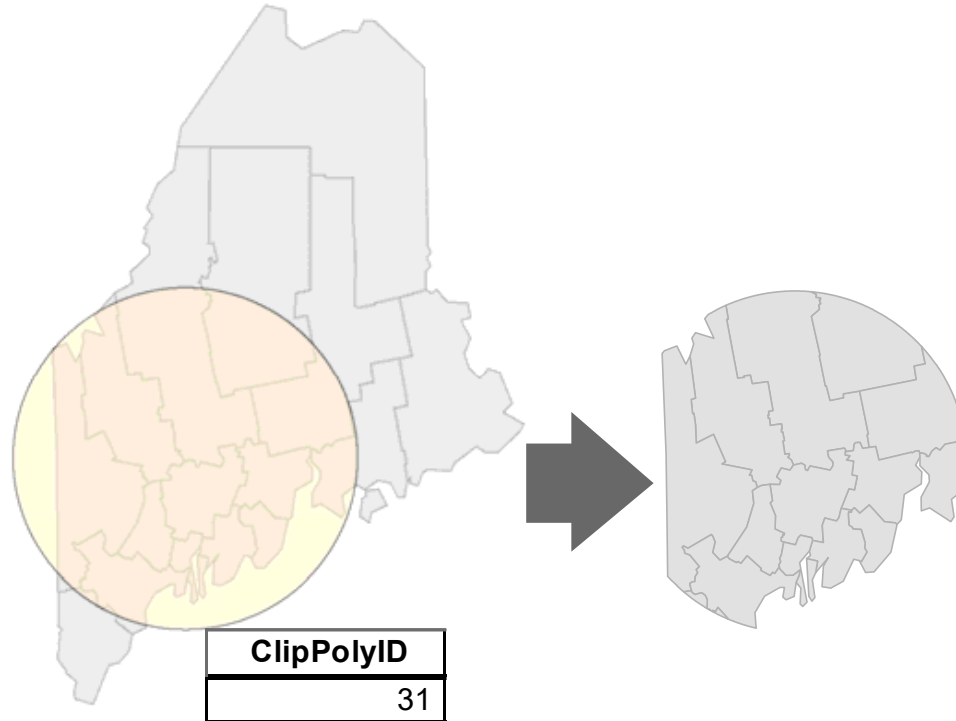
`Spatial properties` + `Spatial Relationships` =

`Spatial Analysis`

Spatial analysis

`Spatial analysis` =

`Geometric Operations` + `Spatial Queries`

Vector operations

NAME
Androscoggin
Aroostook
Cumberland
Franklin
Hancock
Kennebec
Knox
Lincoln
Oxford
Penobscot
Piscataquis
Sagadahoc
Somerset
Waldo
Washington
York

ClipPolyID
31

NAME
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Somerset
Waldo
York

Gimdond, M. 2021. Intro to GIS and Spatial Analysis. [online]
https://mgimond.github.io/Spatial/introGIS.html

Vector operations

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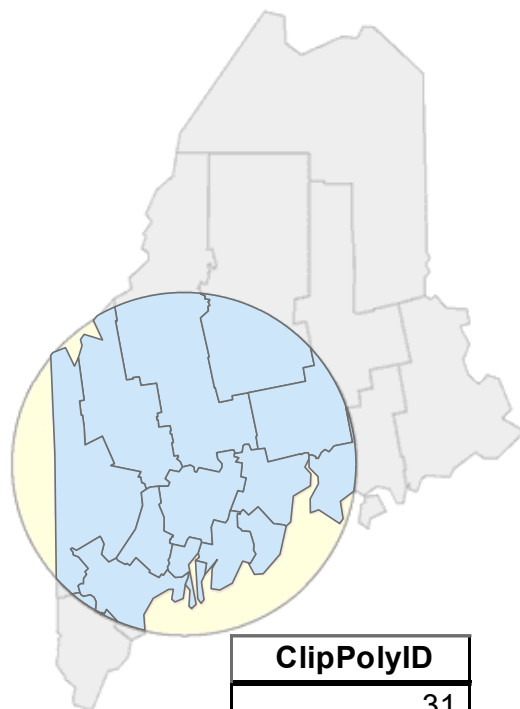
ClipPolyID
31

NAME	ClipPolyID
Androscoggin	31
Cumberland	31
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Vector operations

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ClipPolyID
31

NAME	ClipPolyID
	31
Androscoggin	31
Aroostook	0
Cumberland	0
Cumberland	31
Franklin	0
Franklin	31
Hancock	0
Hancock	31
Kennebec	31
Knox	31
Lincoln	31
Oxford	0
Oxford	31
Penobscot	0

Gimdond, M. 2021. Intro to GIS and Spatial Analysis. [online]
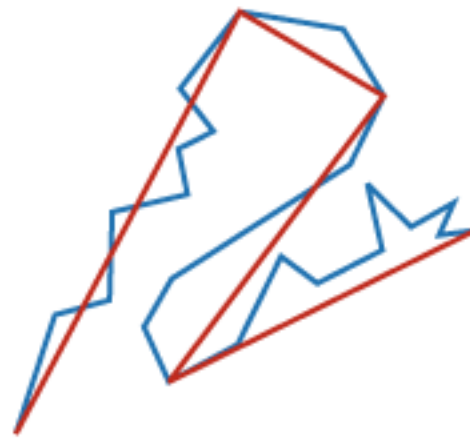https://mgimond.github.io/Spatial/introGIS.html
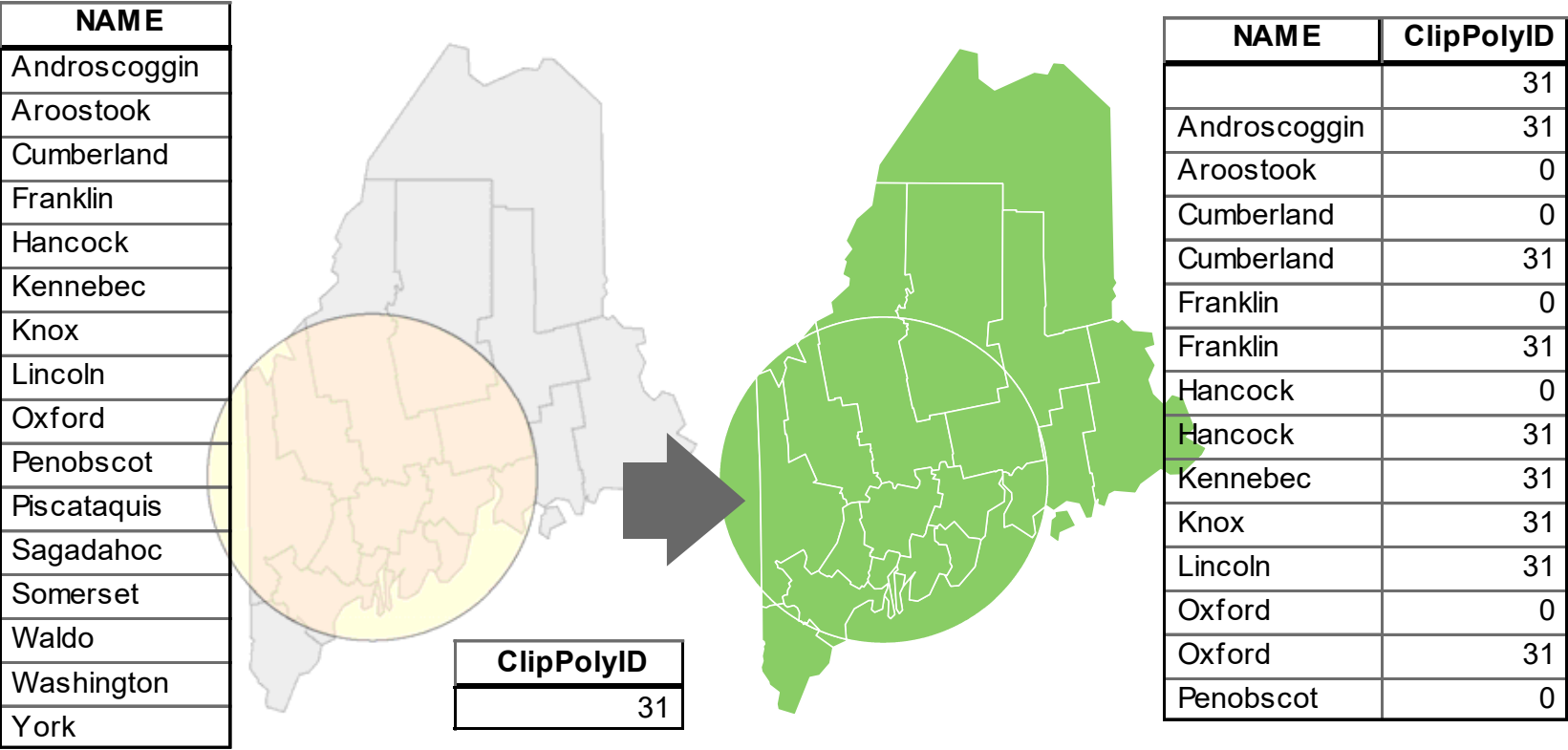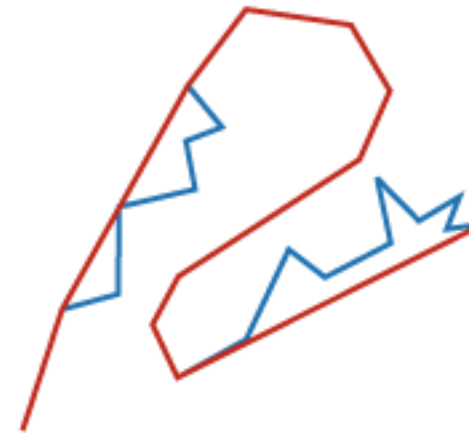
Vector operations - Dissolve

INPUT

OUTPUT
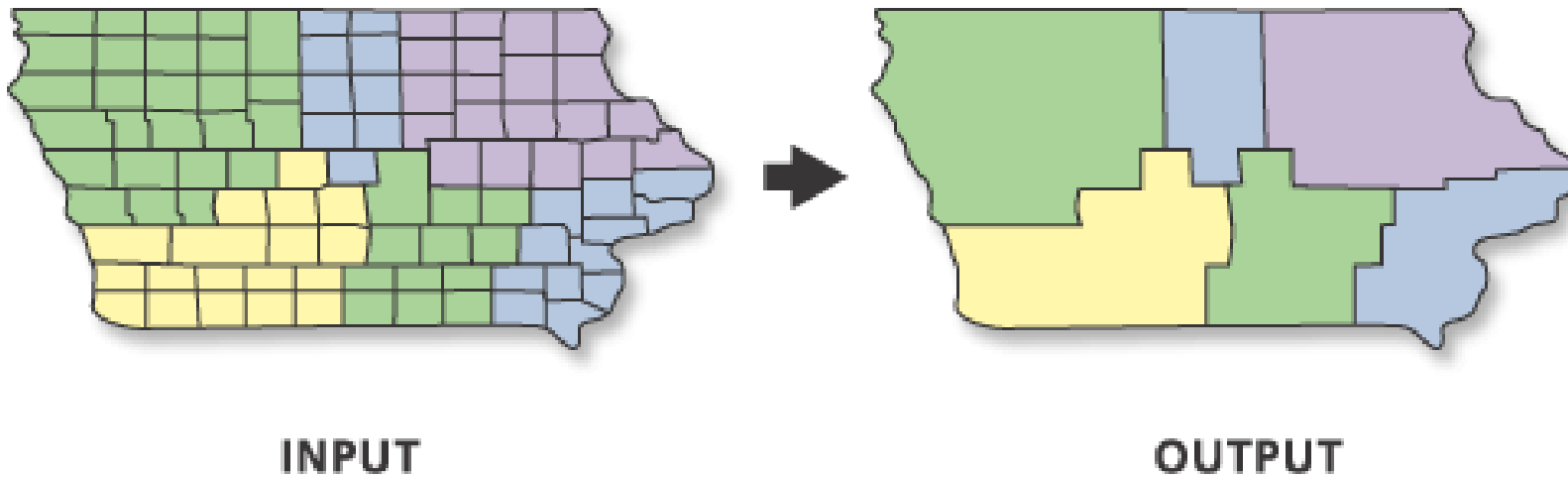
ESRI. 2021. Dissolve. [online]
https://pro.arcgis.com/en/pro-app/latest/tool-reference/data-management/dissolve.htm
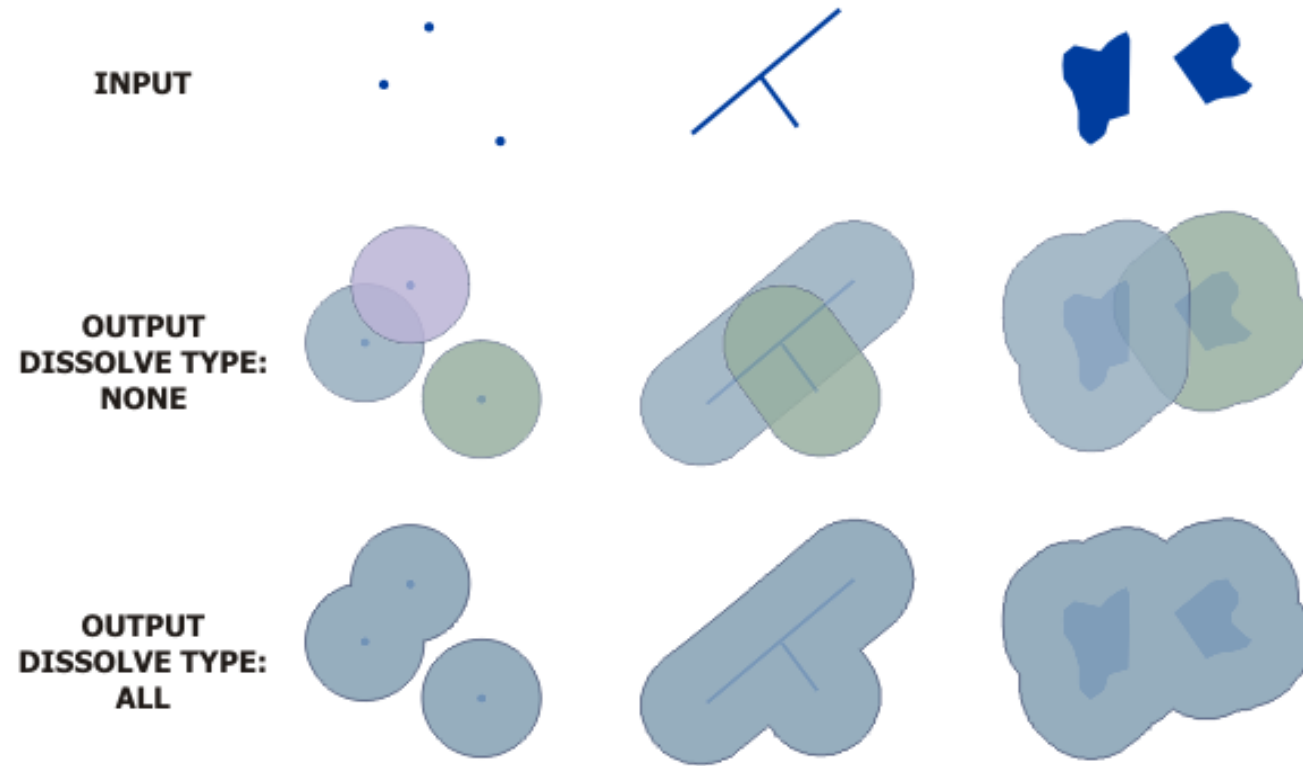
Vector operations - Simplify

POINT REMOVE   BEND SIMPLIFY
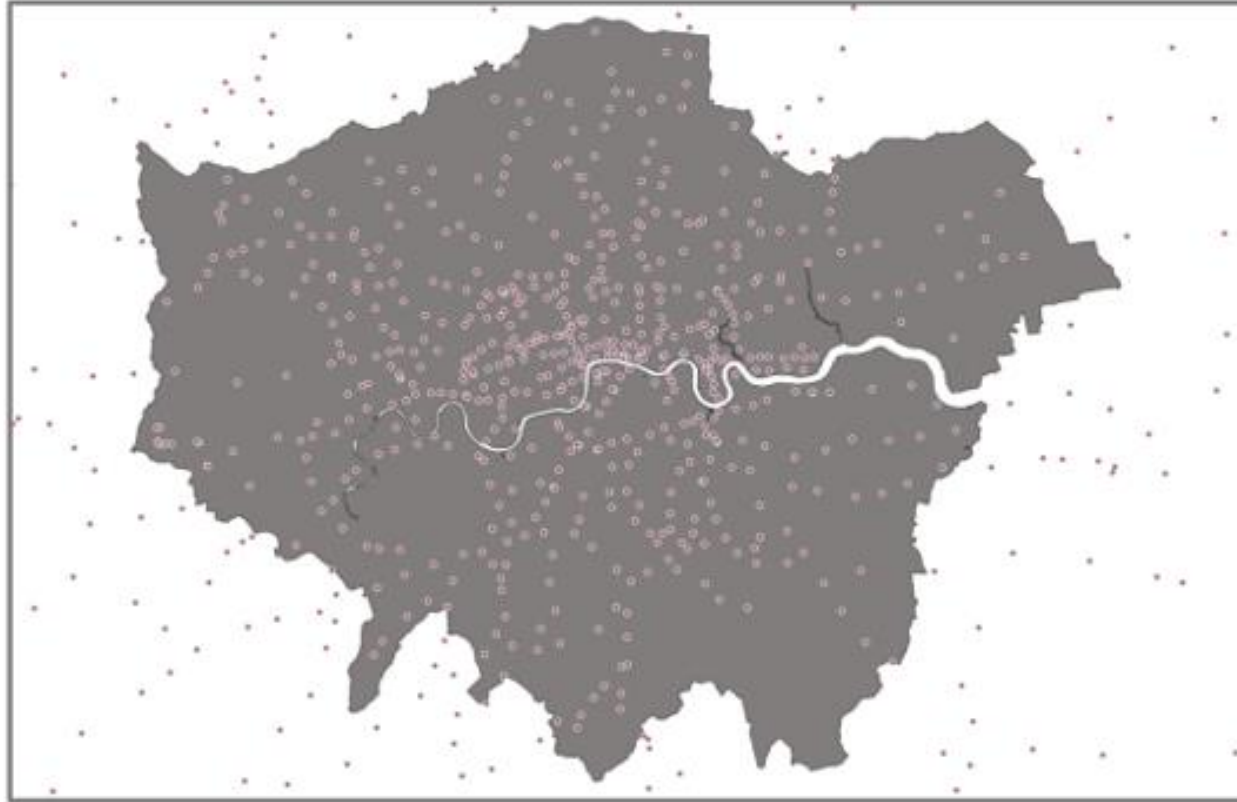
ORIGINAL
SIMPLIFIED

ESRI. 2021. Simplify line. [online]
https://desktop.arcgis.com/en/arcmap/10.3/tools/cartography-toolbox/simplify-line.htm

Vector operations - Simplify

Vector operations - Buffer

ESRI. 2021. Buffer. [online]
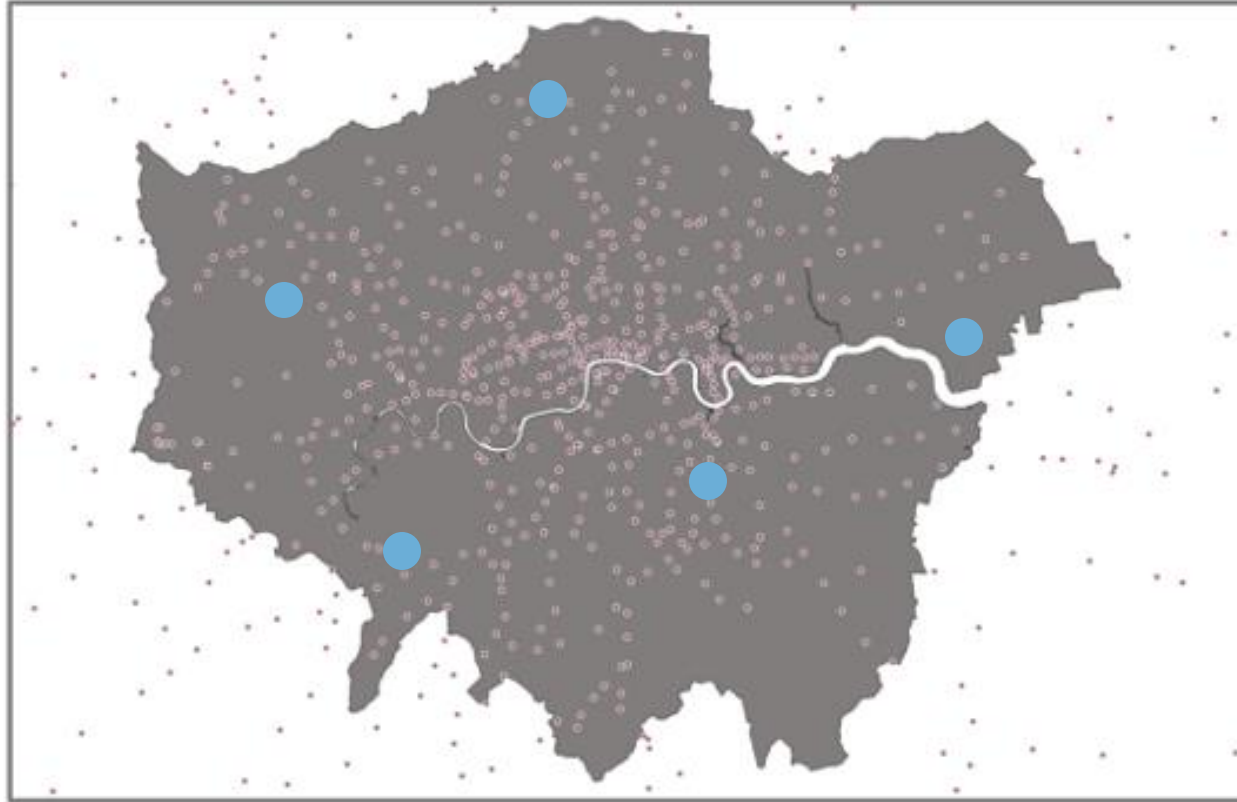https://pro.arcgis.com/en/pro-app/latest/tool-reference/analysis/buffer.htm
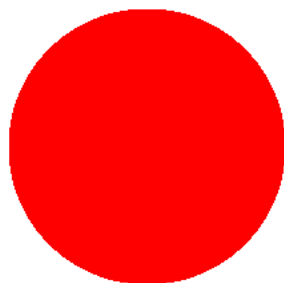
Vector operations – Spatial query

Vector operations – Attribute query

RStudio

Conclusion

- The core of spatial analysis comes down to executing geometric operations and spatial queries.
- Spatial analysis relies therewith on the spatial properties of an object as well as on the spatial relationships both *within* and *between* spatial objects.

Questions

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