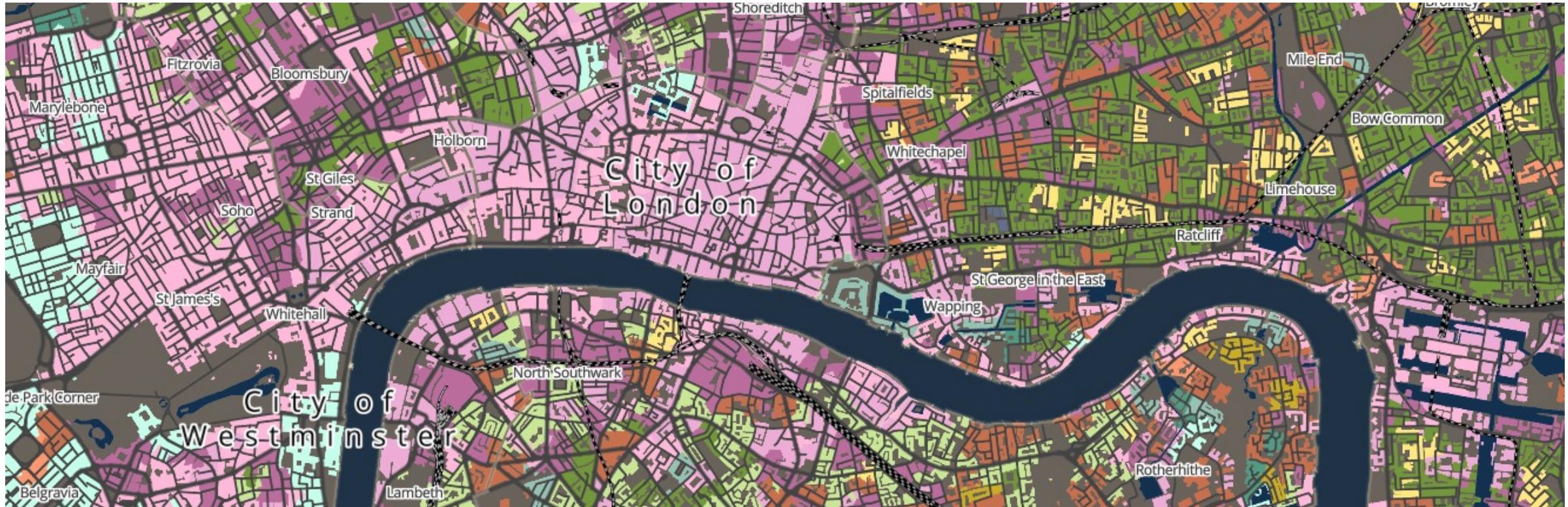


# Geocomputation

## Geometric Operations and Spatial Queries



# Where are we at?

## *Part I: Foundational Concepts*

W1 Geocomputation: An Introduction

W2 GIScience and GIS software

W3 Cartography and Visualisation



QGIS

W4 Programming for Data Analysis

W5 Programming for Spatial Analysis



R

# Where are we at?

## *Part II: Core Spatial Analysis*

W6      **Geometric Operations and Spatial Queries**

W7      Point Pattern Analysis

W8      Spatial Autocorrelation

R

## *Part III: Advanced Spatial Analysis*

W9      Rasters, Zonal Statistics and Interpolation

W10     Transport Network Analysis

R

# Before we start

- Go to [www.menti.com](http://www.menti.com)
- Use code: XXXX XXXX

# This week

- Spatial properties
- Spatial operations
- Spatial relationships

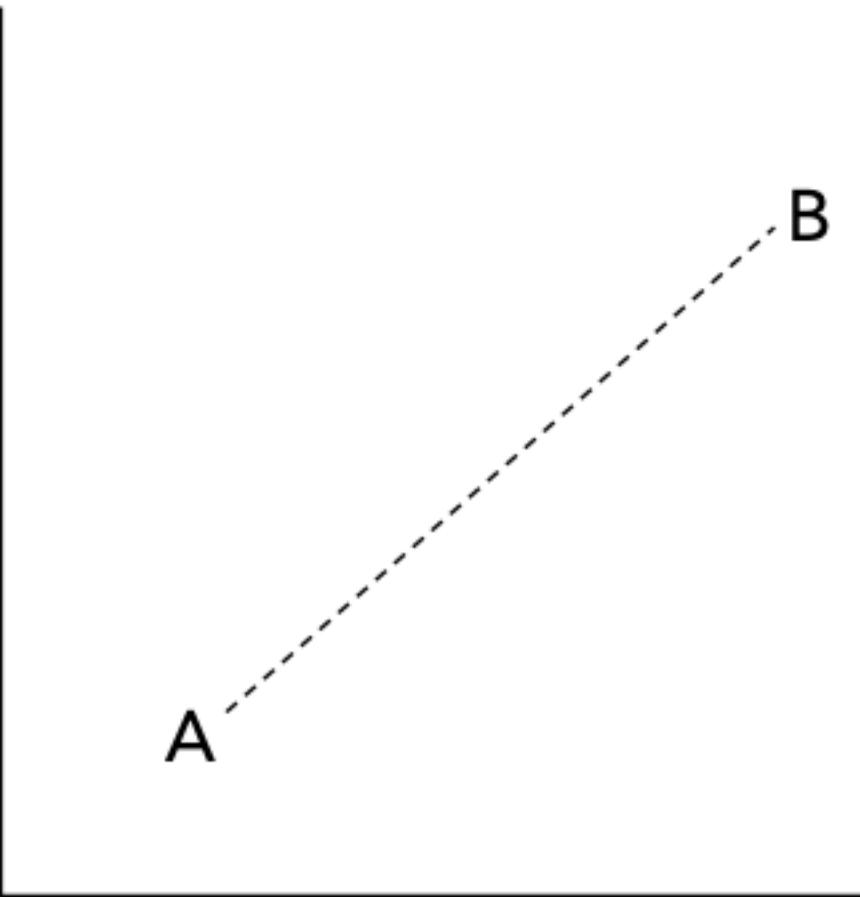
This week



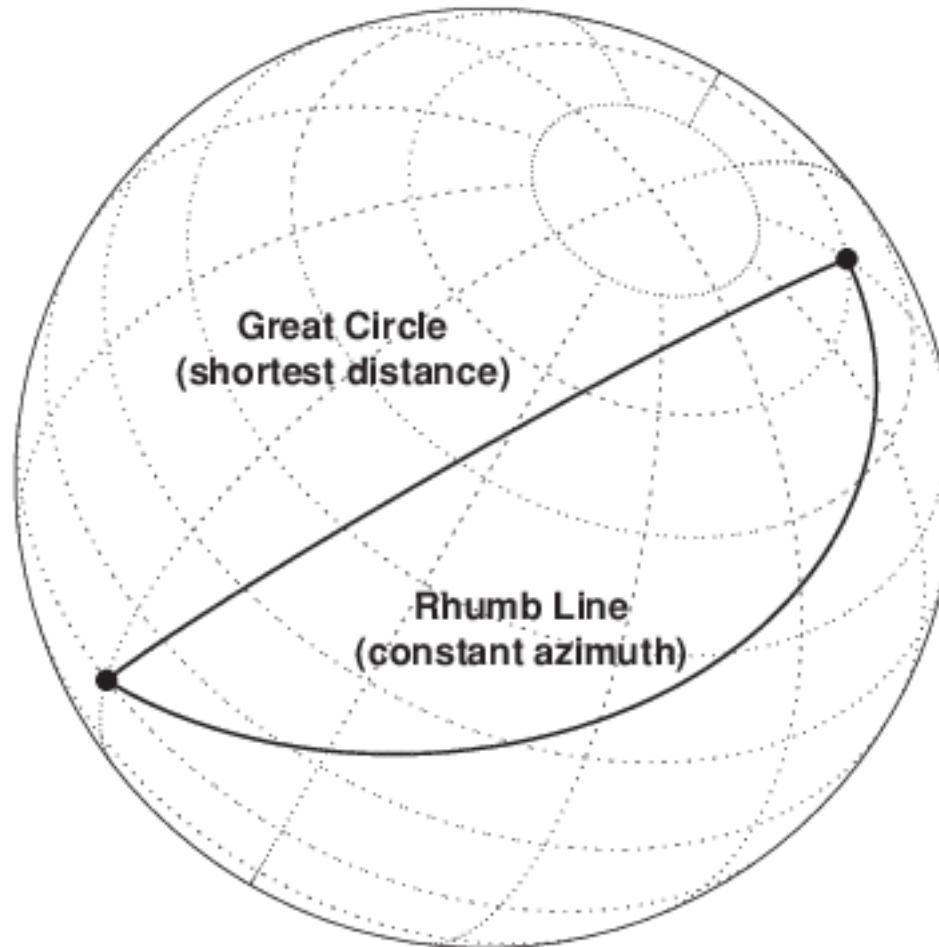
# Spatial properties

- Much of spatial data involves the execution of spatial maths 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.

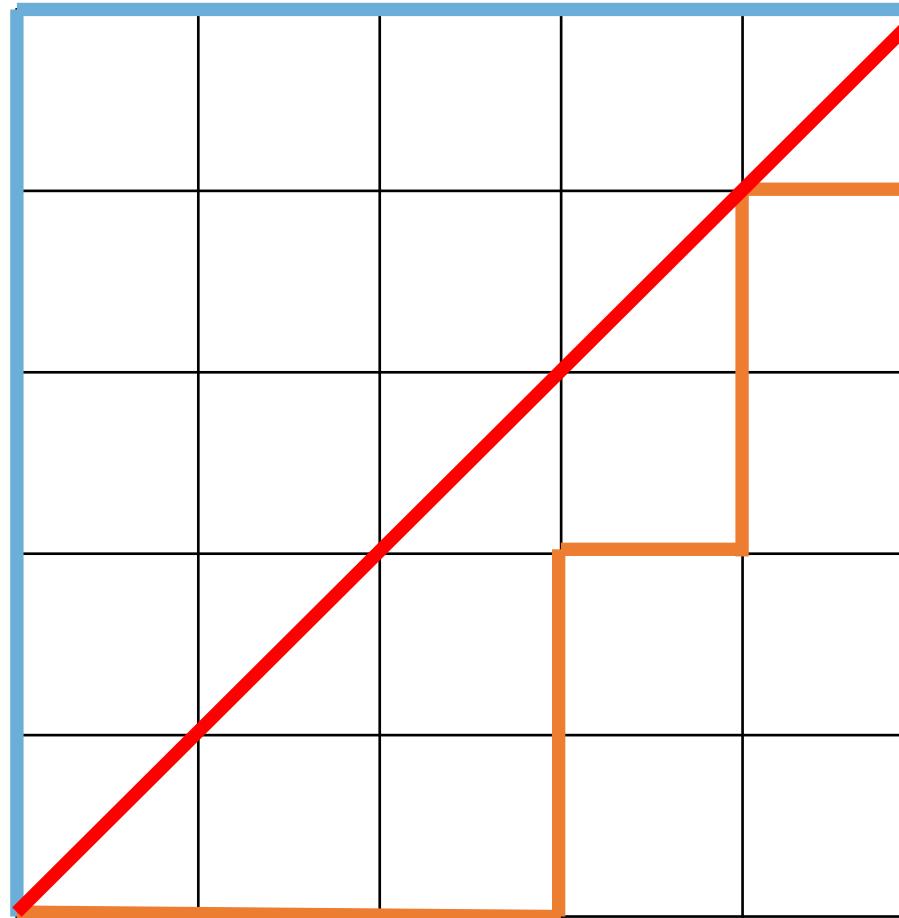
# Distance



# Distance



# Distance



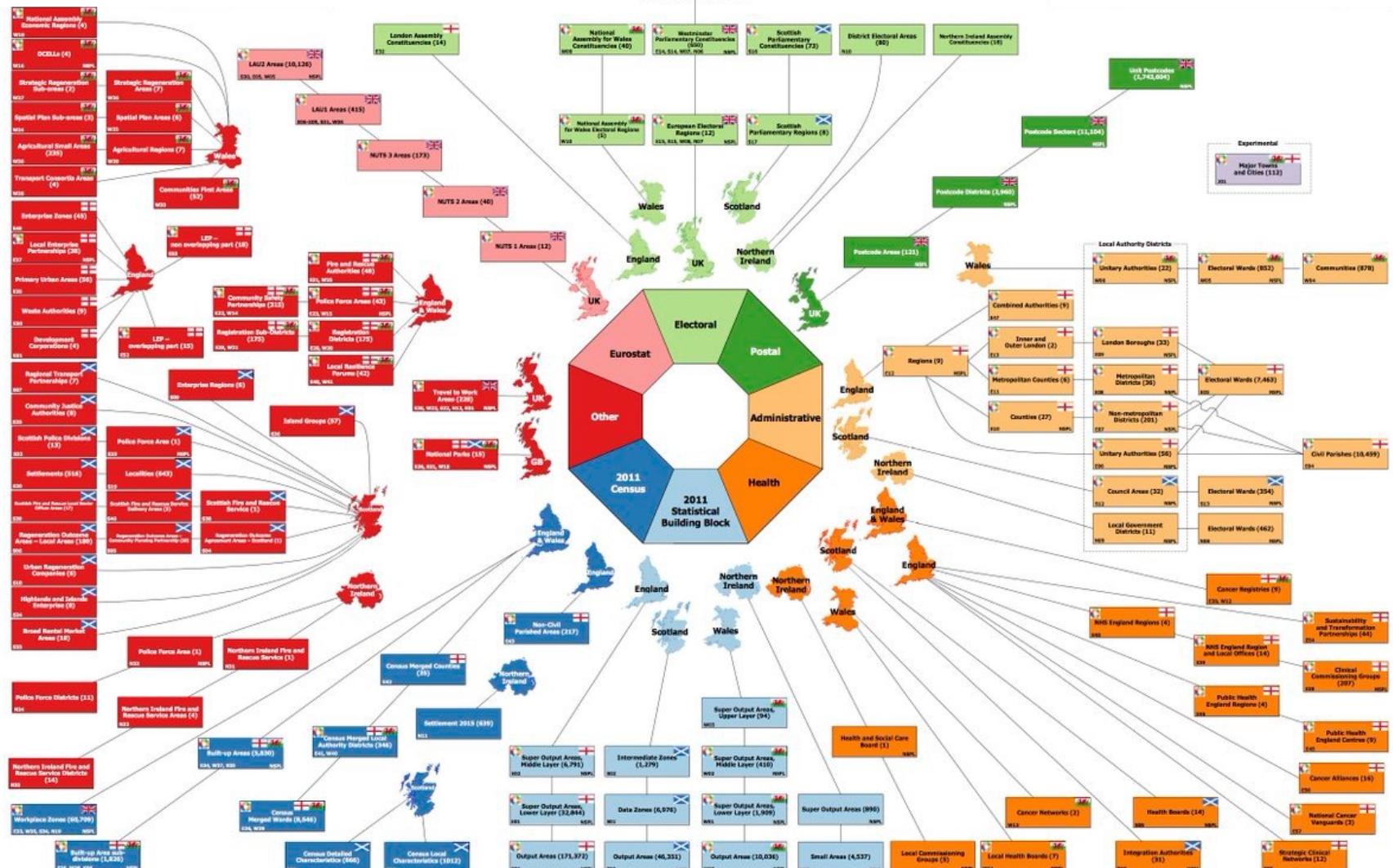
Area



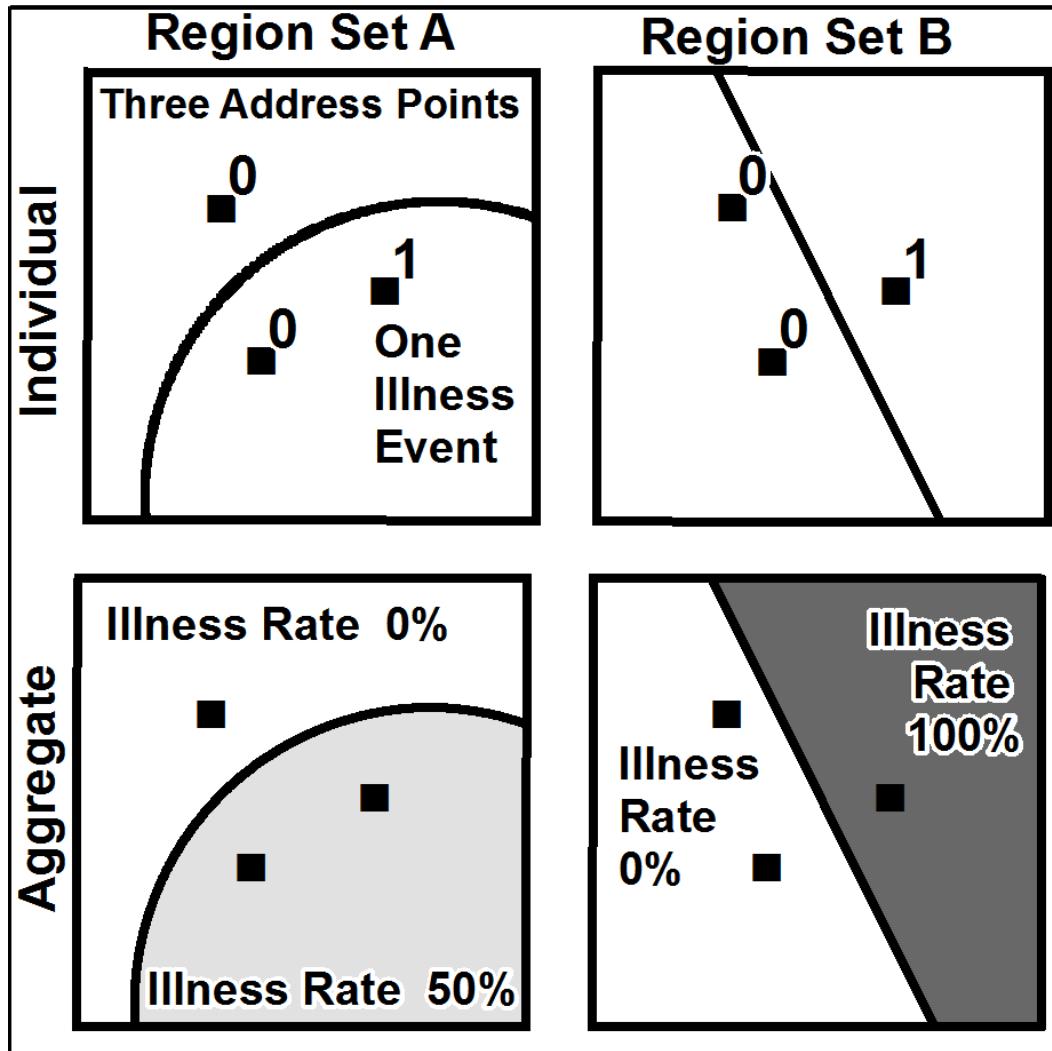
# Area

- 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 in mind MAUP.

# Administrative Geographies



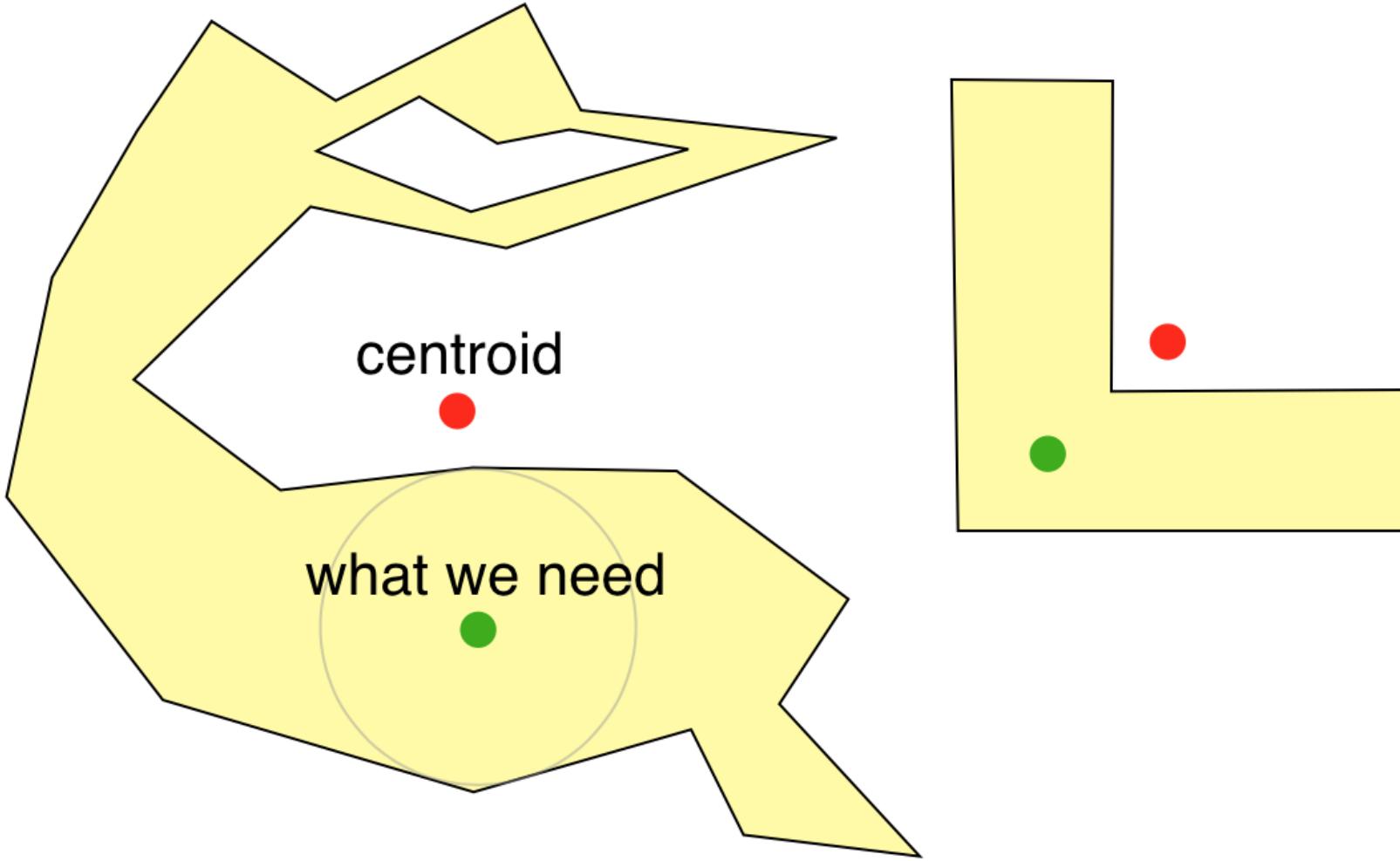
# Modifiable Areal Unit Problem



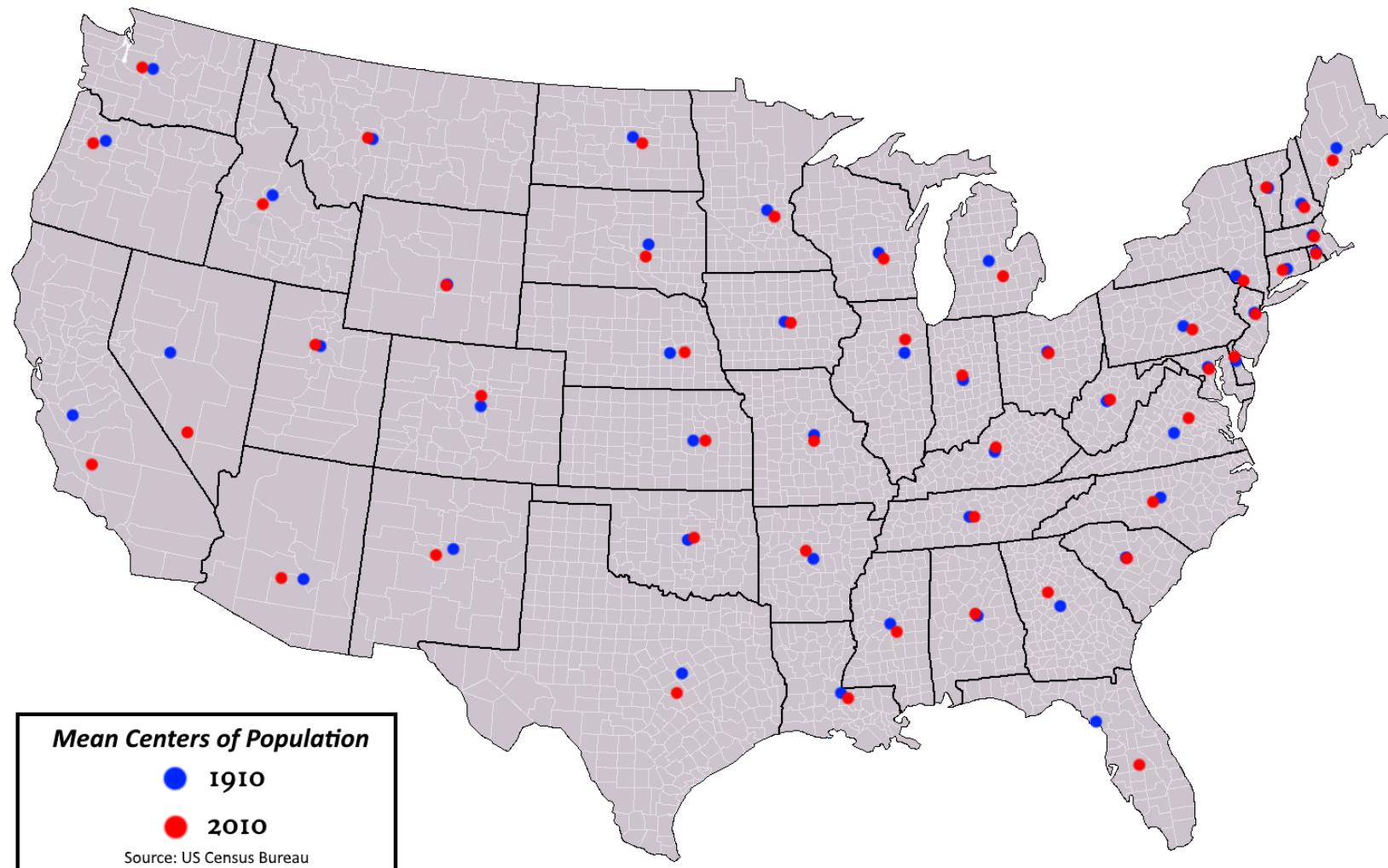
# Shape

- 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



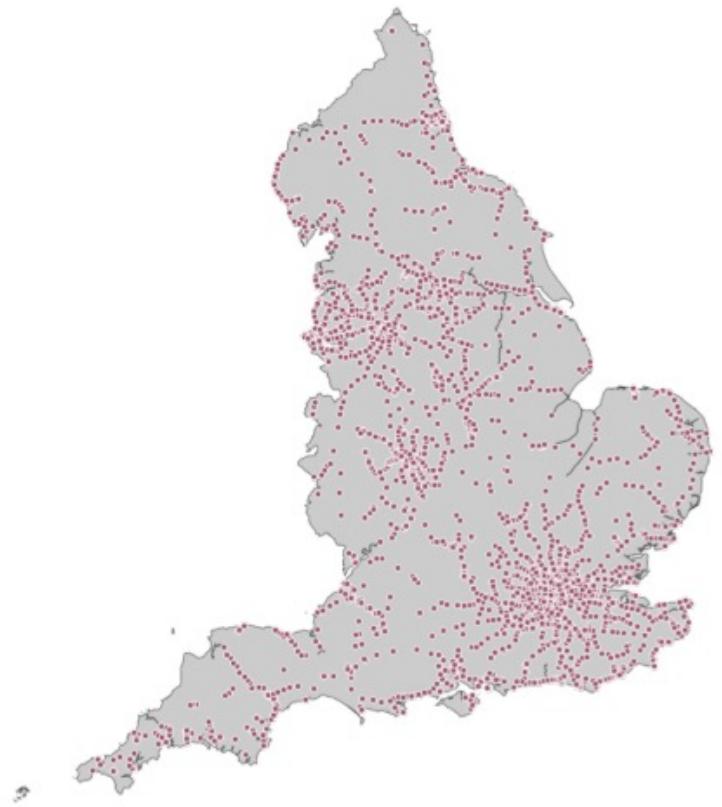
# Shape



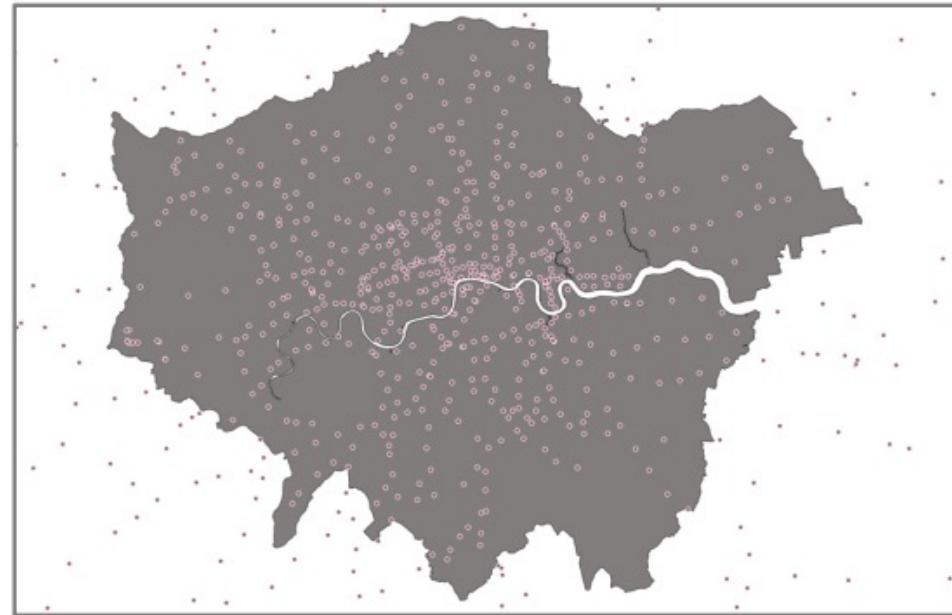
# Spatial operations

- 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

<b>Equals</b> A is the same as B	
<b>Touches</b> A touches B	
<b>Overlaps</b> A and B have multiple points in common	
<b>Contains</b> A contains B	
<b>Disjoint</b> A shares nothing with B	
<b>Covers</b> A covers B (or vice versa)	
<b>Crosses</b> A and B have at least one point in common	

# 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

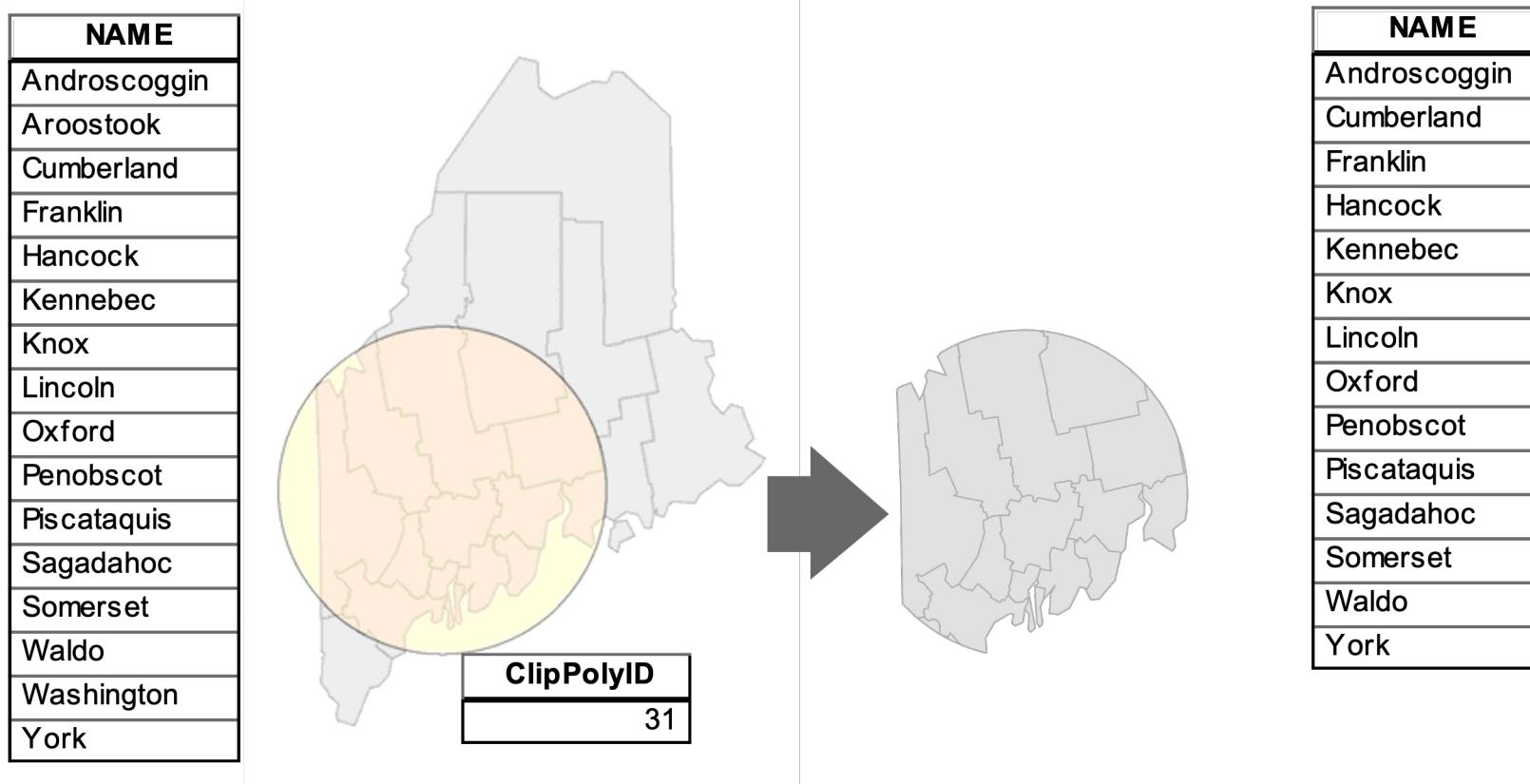
Spatial properties + Spatial Relationships =  
Spatial Analysis

# Spatial analysis

Spatial analysis =

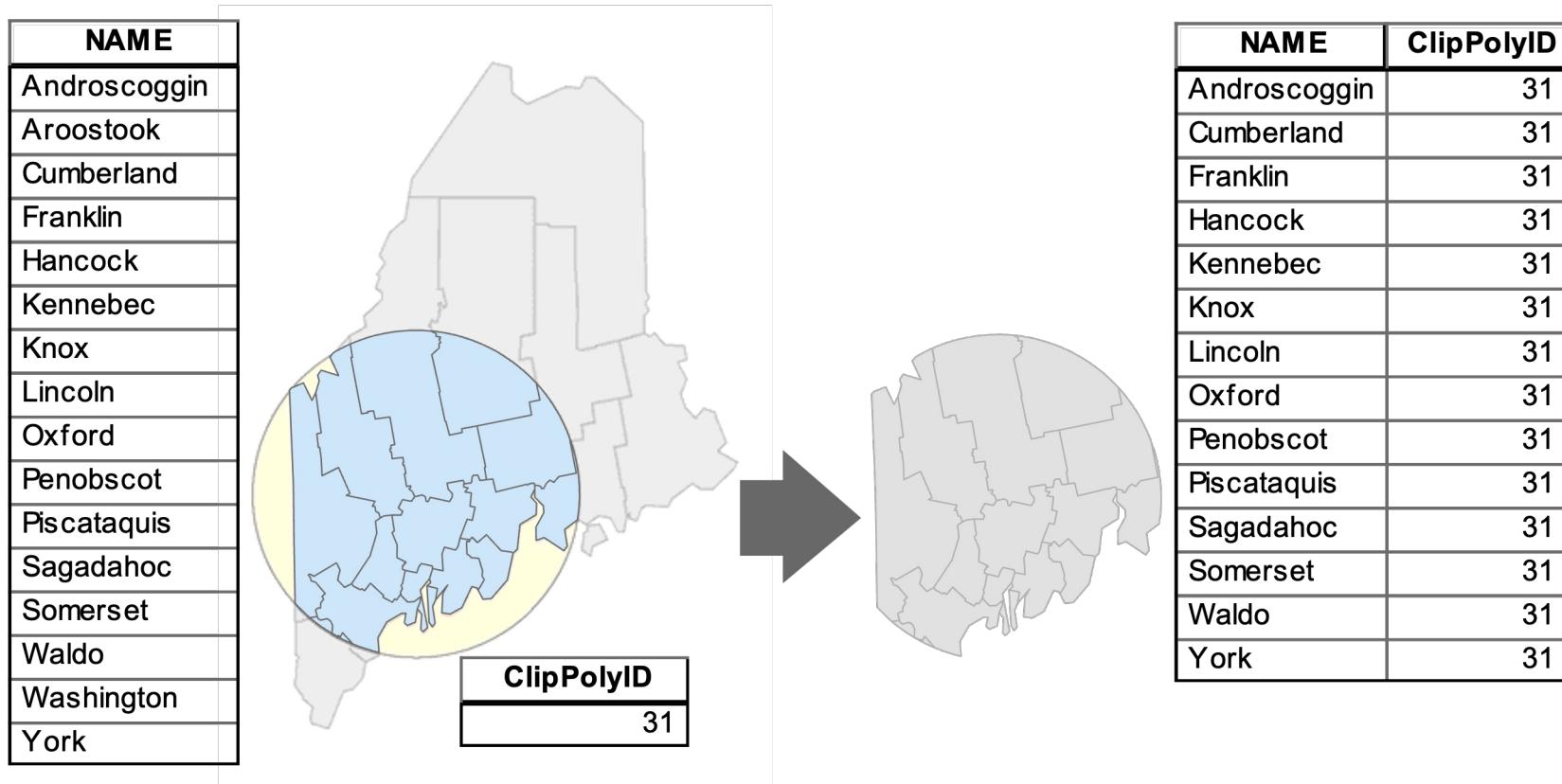
Geometric Operations + Spatial Queries

# Vector operations



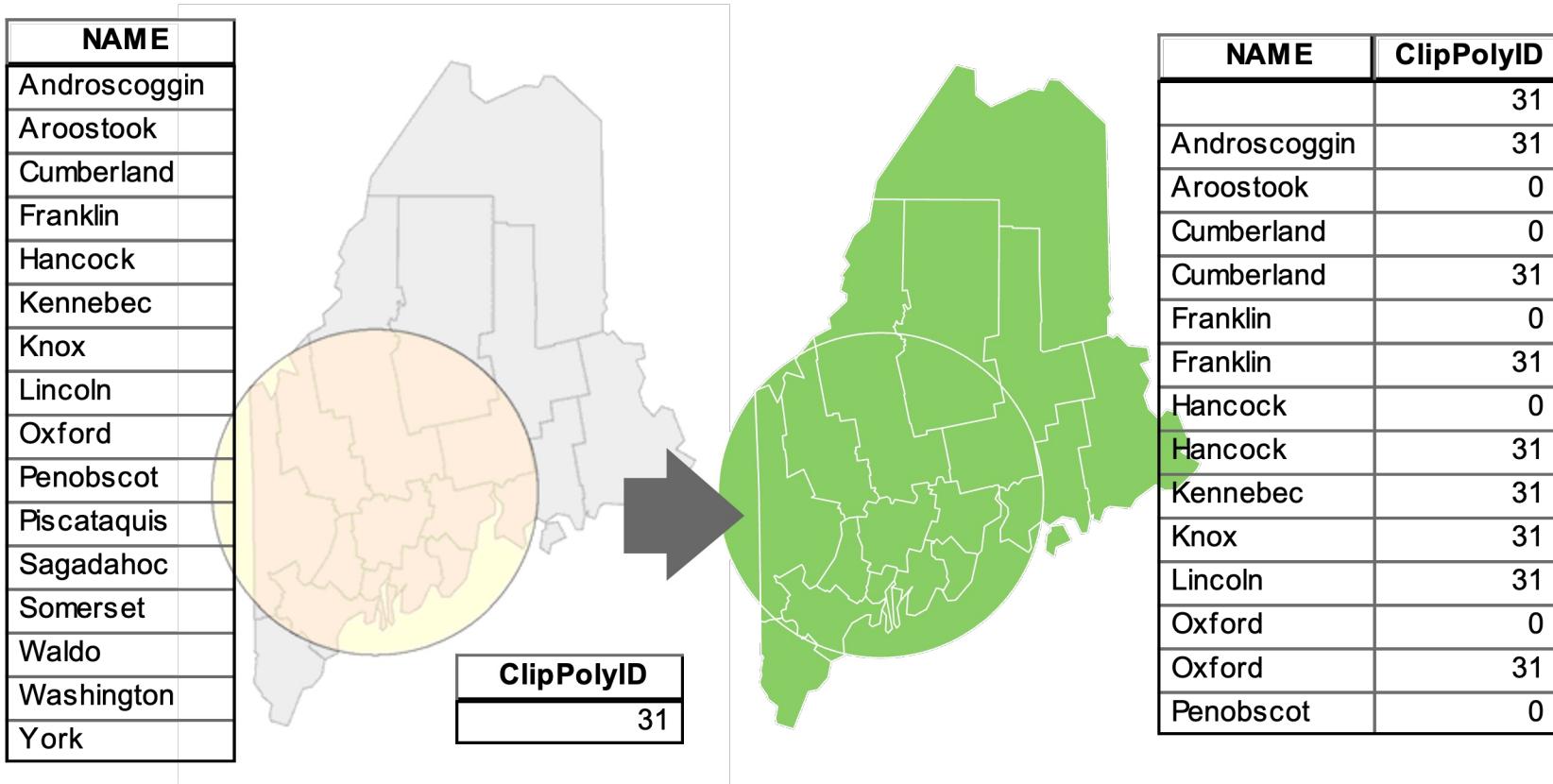
Gimdond, M. 2021. Intro to GIS and Spatial Analysis. [online]  
<https://mgimond.github.io/Spatial/introGIS.html>

# Vector operations



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

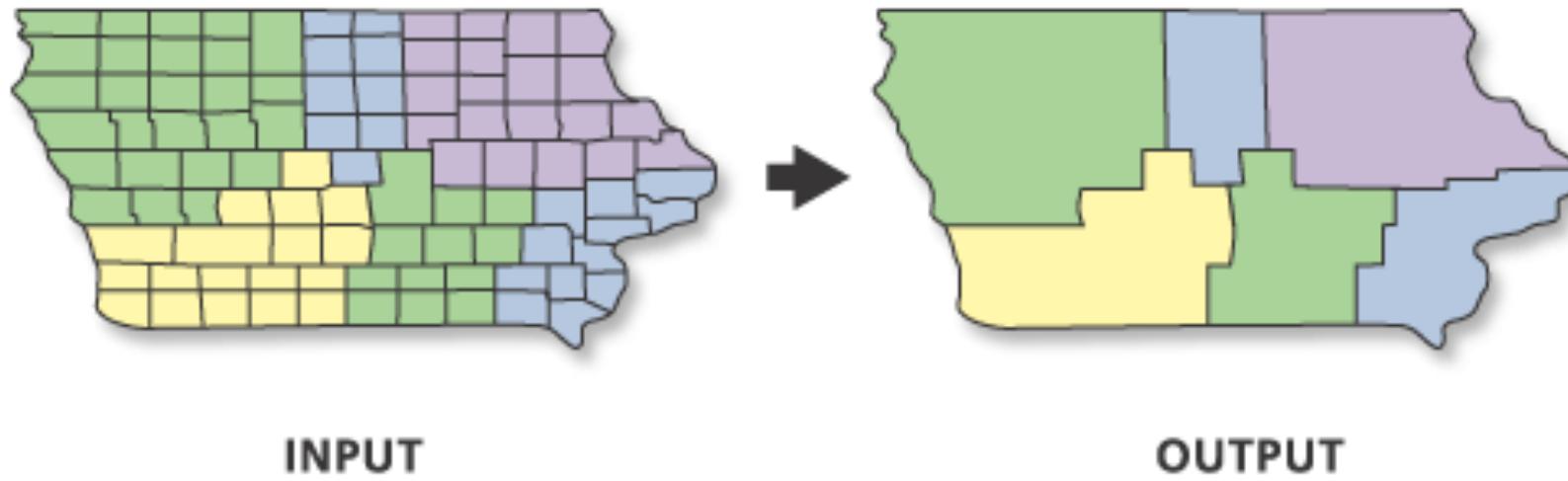
# Vector operations



Gimdond, M. 2021. Intro to GIS and Spatial Analysis. [online]

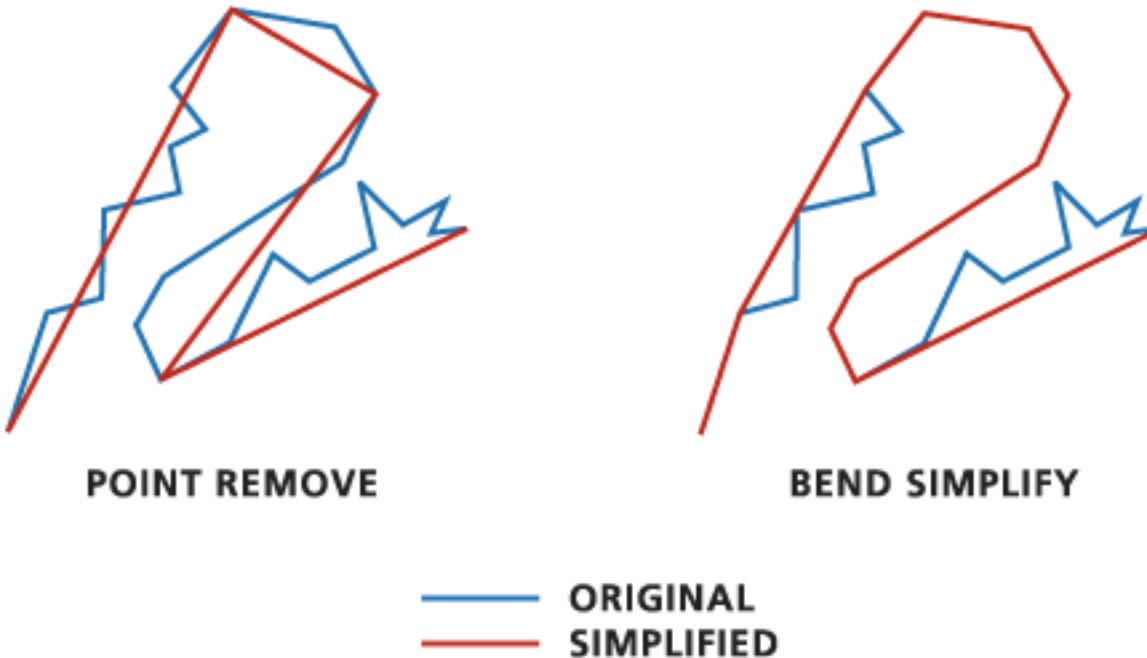
<https://mgimond.github.io/Spatial/introGIS.html>

# Vector operations - Dissolve



ESRI. 2021. Dissolve. [online]  
<https://pro.arcgis.com/en/pro-app/latest/tool-reference/data-management/dissolve.htm>

# Vector operations - Simplify

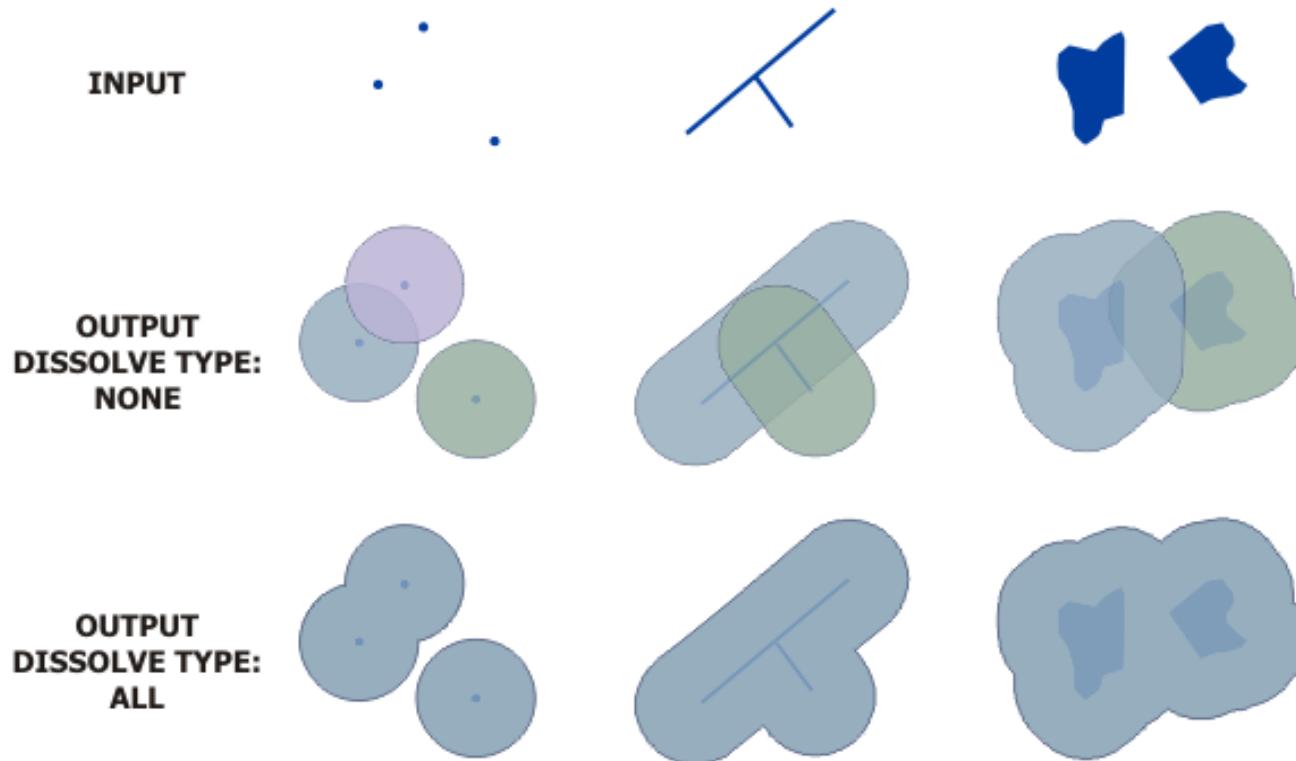


ESRI. 2021. Simplify line. [online]  
<https://desktop.arcgis.com/en/arcmap/10.3/tools/cartography-toolbox/simplify-line.htm>

# Vector operations - Simplify

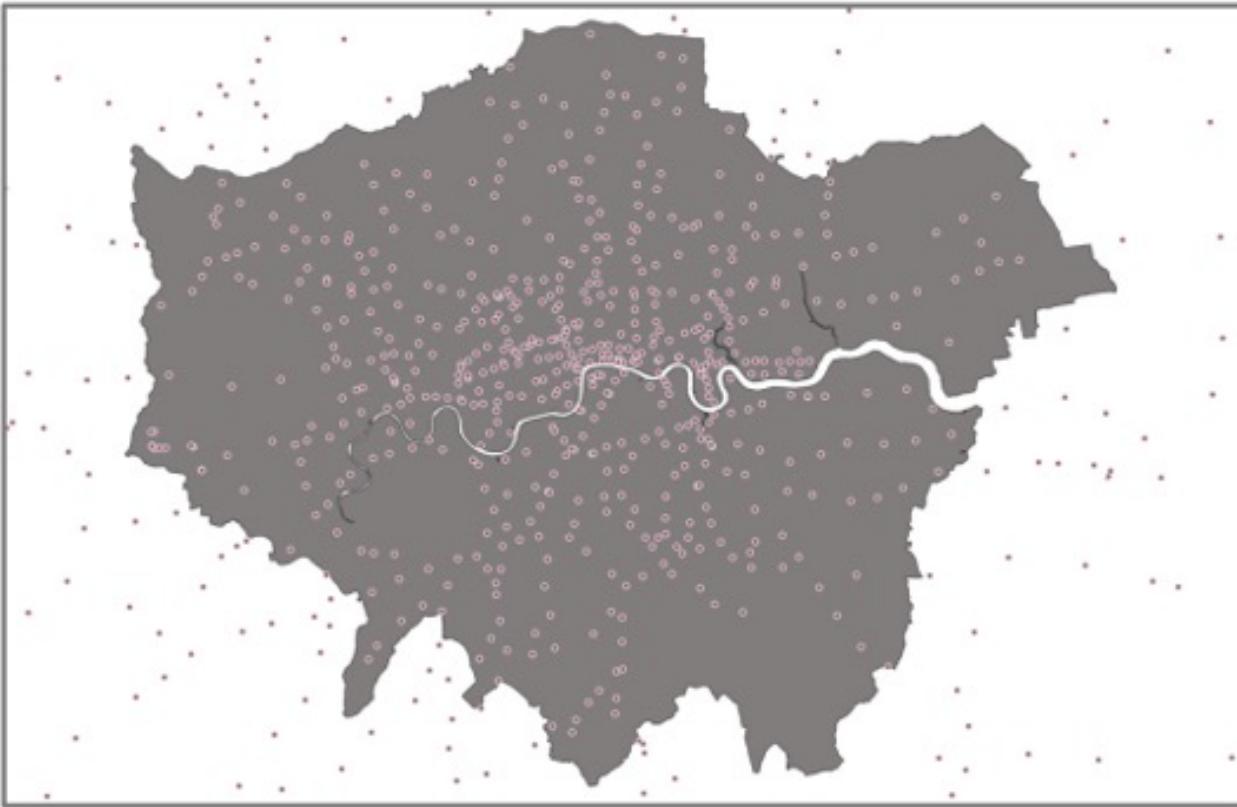


# Vector operations - Buffer

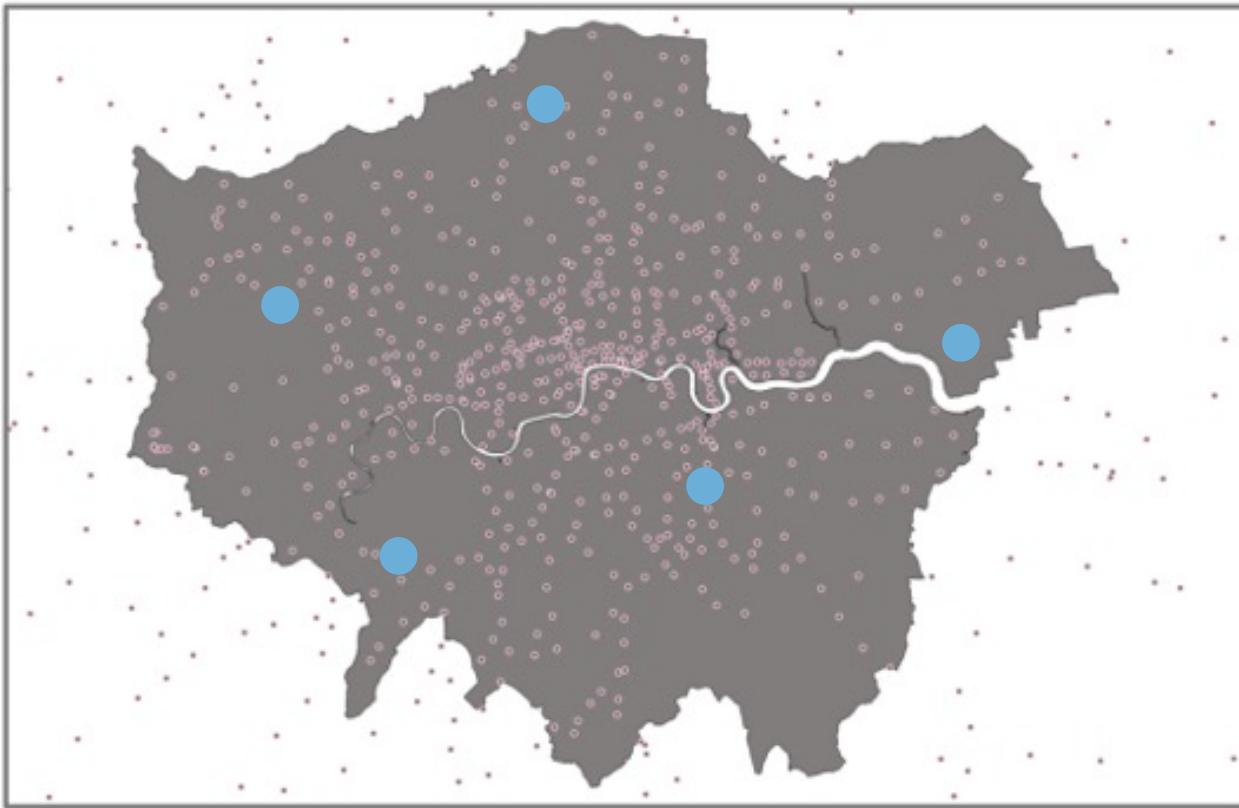


ESRI. 2021. Buffer. [online]  
<https://pro.arcgis.com/en/pro-app/latest/tool-reference/analysis/buffer.htm>

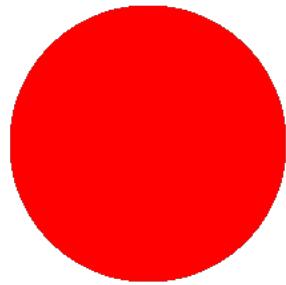
# Vector operations – Spatial query



# Vector operations – Attribute query



RStudio



LIVE

# 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.

# Assessment

- Social Atlas Coursework Assessment (60%): The first assessment will involve the completion of a spatial analysis project, based on the theory, concepts and application learnt during the module. For this coursework you are required to create a small “social atlas” on a topic or area that interests you. Deadline: April 22 2024.
- On Moodle: guidance as well as examples.

# Assessment

- You should create a minimum of 8 maps - and a maximum of 10 - and not exceed 1,500 words.
- You can choose a specific theme, e.g. "Healthy Living", "Cost of Living in England" or create a research question to answer.
- You should aim to utilise a range of different techniques taught in the Geocomputation module to explore your topic – but make sure you apply the techniques in appropriate manner and with the right data types.
- Greater London cannot be used as a case study.

# Assessment

The screenshot shows a Moodle course page for 'Topic: Assessment | GEOG0030'. The page title is 'moodle.ucl.ac.uk/course/view.php?id=38486&section=3#tabs-tree-start'. The header includes the UCL logo, 'Home', 'My courses', 'Edit mode' (disabled), and a user icon. The main content area has a sidebar with a grid icon and a back arrow icon.

## Module assessment details

Geocomputation is assessed through two separate assignments:

- Social Atlas Coursework Assessment (60%).** The first assessment will involve the completion of a 1,500 word spatial analysis project, based on the theory, concepts and application learnt during the module. For this coursework you are required to create a small "social atlas" on a topic or area that interests you.
- Exam Assessment (40%).** The second assessment will take the form of a written two-hour exam.

## Marking criteria

For the coursework assignment, the marking criteria that will be used can be found in the Geography Coursework Marking Matrix: [\[Link\]](#)

For the exam, the marking criteria that will be used can be found in the Geography Exam Marking Matrix: [\[Link\]](#)

## Instructions and examples

[GEOG0030 Assessment: Social Atlas](#) 105.1 KB PDF document

[GEOG0030 Assessment: Data Descriptor Table](#) 72.2 KB PDF document

[Back to top](#)

# Assessment

The screenshot shows a web browser window with the title 'GEOG0030' at the top. The URL in the address bar is [jtvdijk.github.io/GEOG0030/11-data.html](https://jtvdijk.github.io/GEOG0030/11-data.html). The page content is organized into several sections:

- Module overview** (dropdown menu):
  - Welcome
  - Foundational Concepts
    - 1 Geocomputation: An Introduction
    - 2 GIScience and GIS software
    - 3 Cartography and Visualisation
    - 4 Programming for Data Analysis
    - 5 Programming for Spatial Analysis
  - Core Spatial Analysis
    - 6 Analysing Spatial Patterns I: Geometric Operations and Spatial Queries
    - 7 Analysing Spatial Patterns II: Point Pattern Analysis
    - 8 Analysing Spatial Patterns III: Spatial Autocorrelation
  - Advanced Spatial Analysis
    - 9 Rasters, Zonal Statistics, and Interpolation
    - 10 Transport Network Analysis
  - Additional Resources
    - 11 Data Sources
- 11 Data Sources**: The main heading for the current page.
- Text**: A paragraph explaining that the list of resources is not exhaustive but contains suggestions of websites that may want to use.
- Info box**: A callout box containing the text: "You are **not limited** to using these datasets for your coursework assignment or your dissertation, but these are merely some suggestions."
- Section 11.1 Open Data**: A heading for the first section of data sources.
- Text**: A paragraph stating that the following websites contain Open Data or link to Open Data from several respectable data providers.
- List**: A bulleted list of 14 data sources:
  - [AfricanUrbanNetwork](#)
  - [AirBnB Data](#)
  - [Bike Docking Data \(ready for R\)](#)
  - [Bing Maps worldwide road detections](#)
  - [Camden Air Action](#)
  - [Consumer Data Research Centre](#)
  - [Department for Environment, Food & Rural Affairs](#)
  - [Edina \(e.g. OS mastermap\)](#)
  - [EU Tourism Data](#)
  - [Eurostat](#)

# Assessment

TL;DR story of at most 1,500 words tied together by 8-10 related maps.

# Questions

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