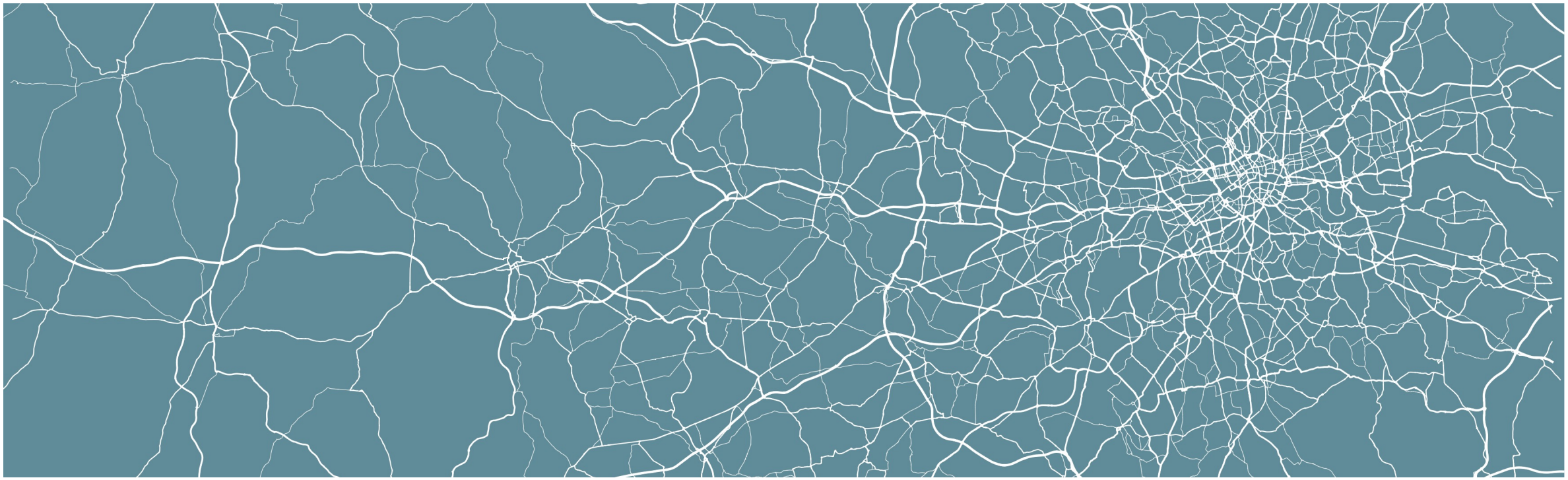
Geocomputation

Geometric Operations and Spatial Queries



UCL

Where are we at?

Part I: Foundational Concepts

W1	Geocomputation: An Introduction	
W2	GIScience and GIS software	QGIS
W3	Cartography and Visualisation	
W4	Programming for Data Analysis	R
W5	Programming for Spatial Analysis	

Where are we at?

Part II: Core Spatial Analysis

W6 **Geometric Operations and Spatial Queries**
W7 Spatial Autocorrelation
W8 Point Pattern Analysis

R

Part III: Advanced Spatial Analysis

W9 Rasters, Zonal Statistics and Interpolation
W10 Transport Network Analysis

R

This week

Before we start

- Go to www.menti.com
- Use code: 8700 3744

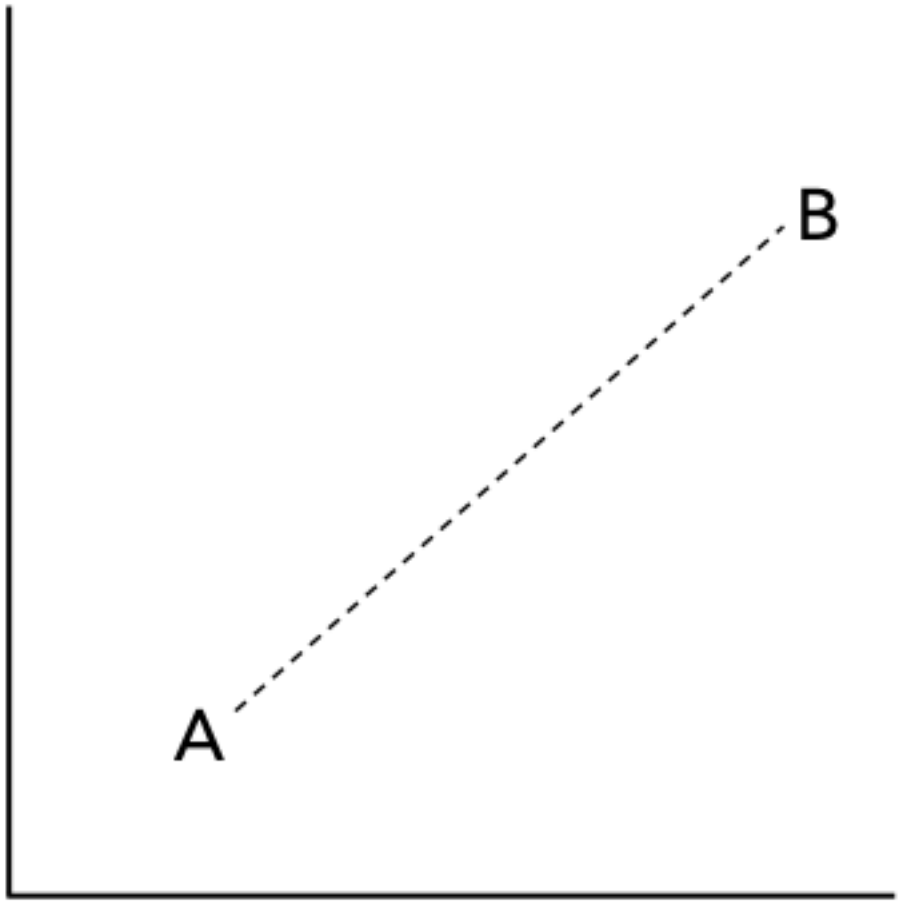
This week

- Spatial properties
- Spatial operations
- Spatial relationships

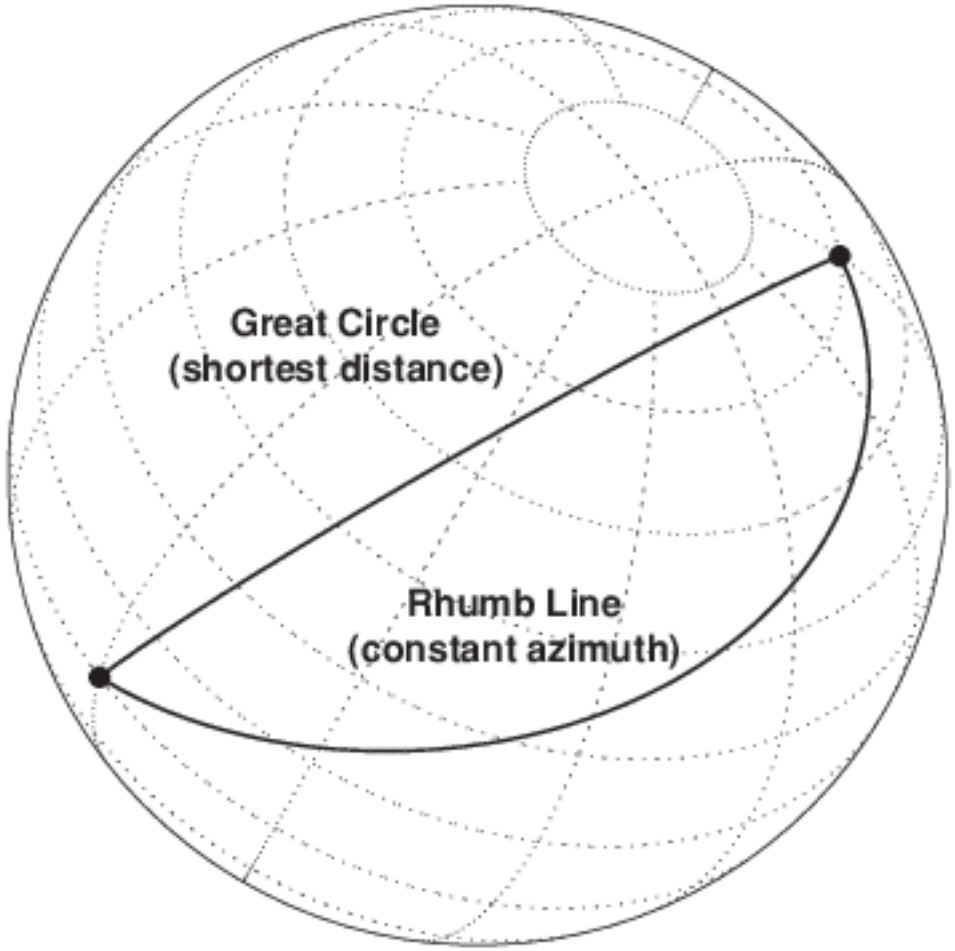
Spatial properties

- 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.

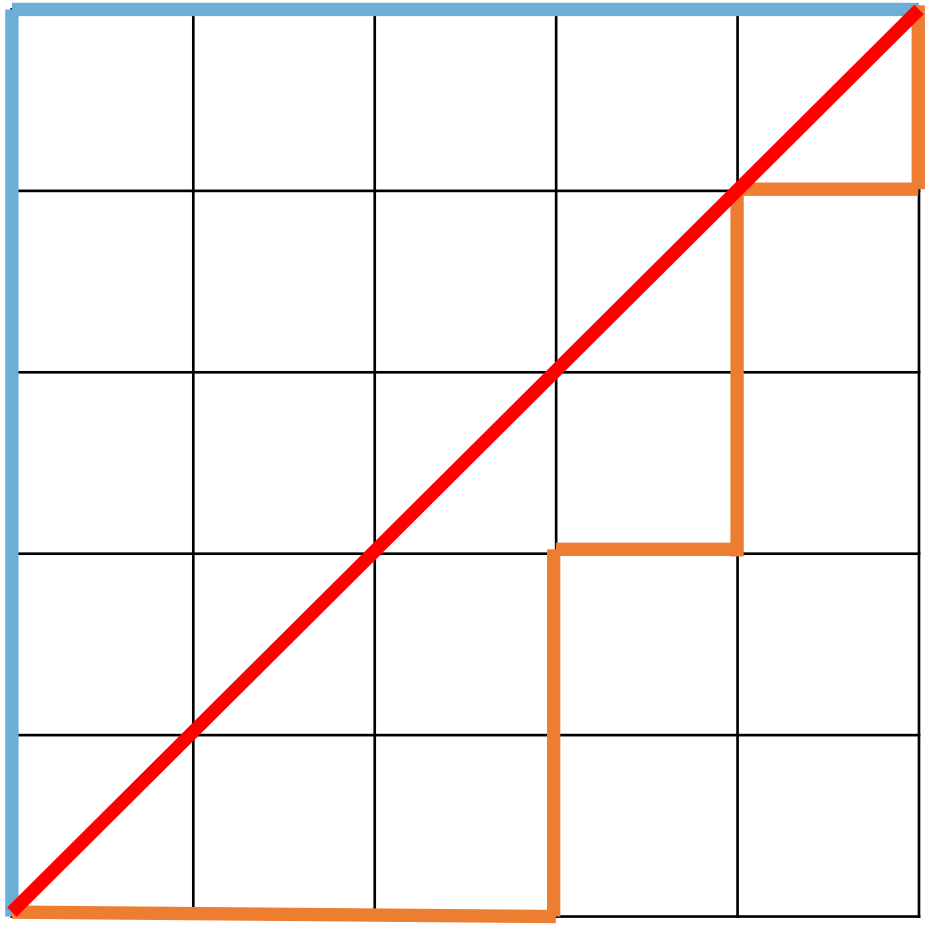
Distance



Distance


Great Circle
(shortest distance)
Rhumb Line
(constant azimuth)

Distance

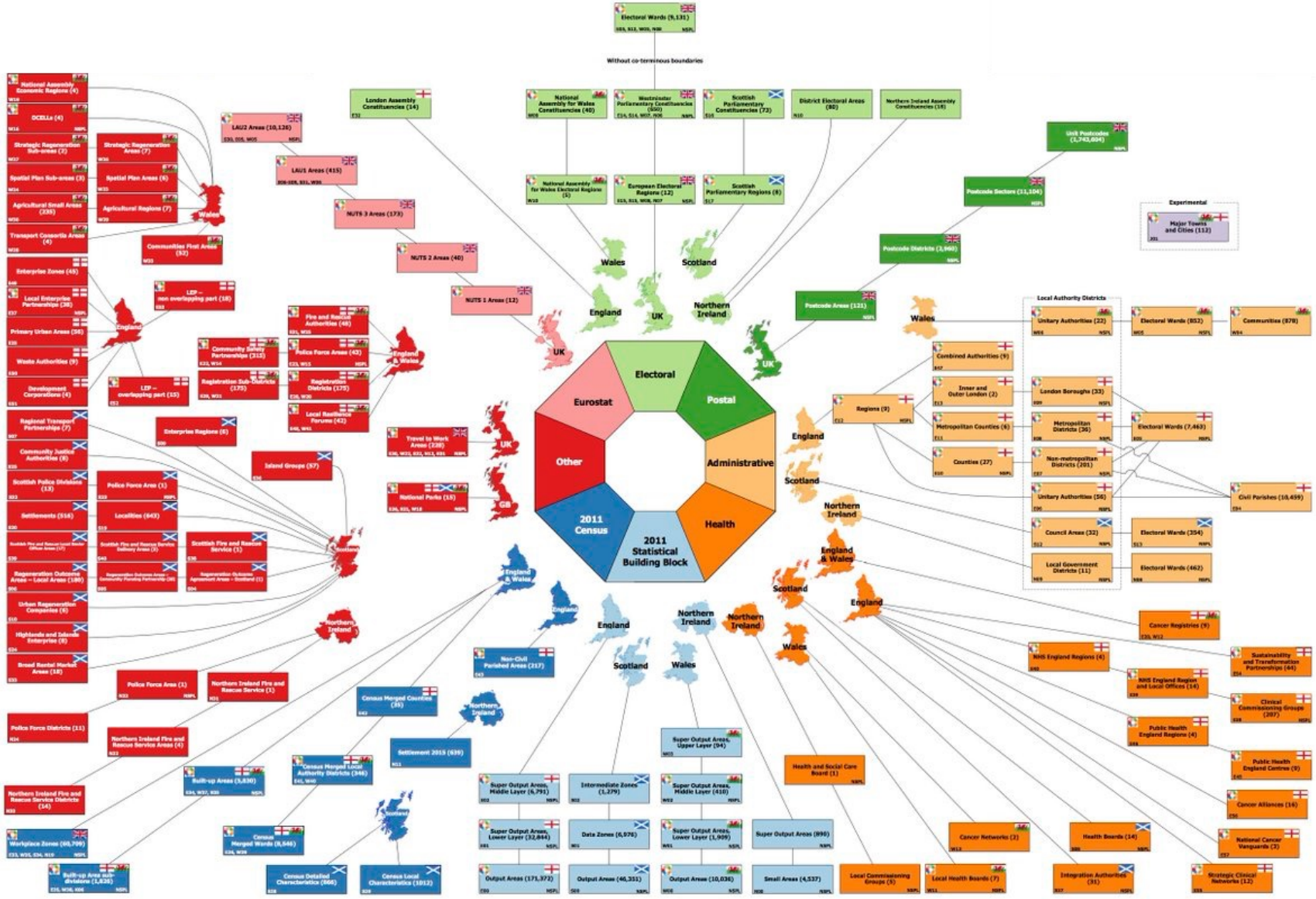


Area

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 in mind MAUP.

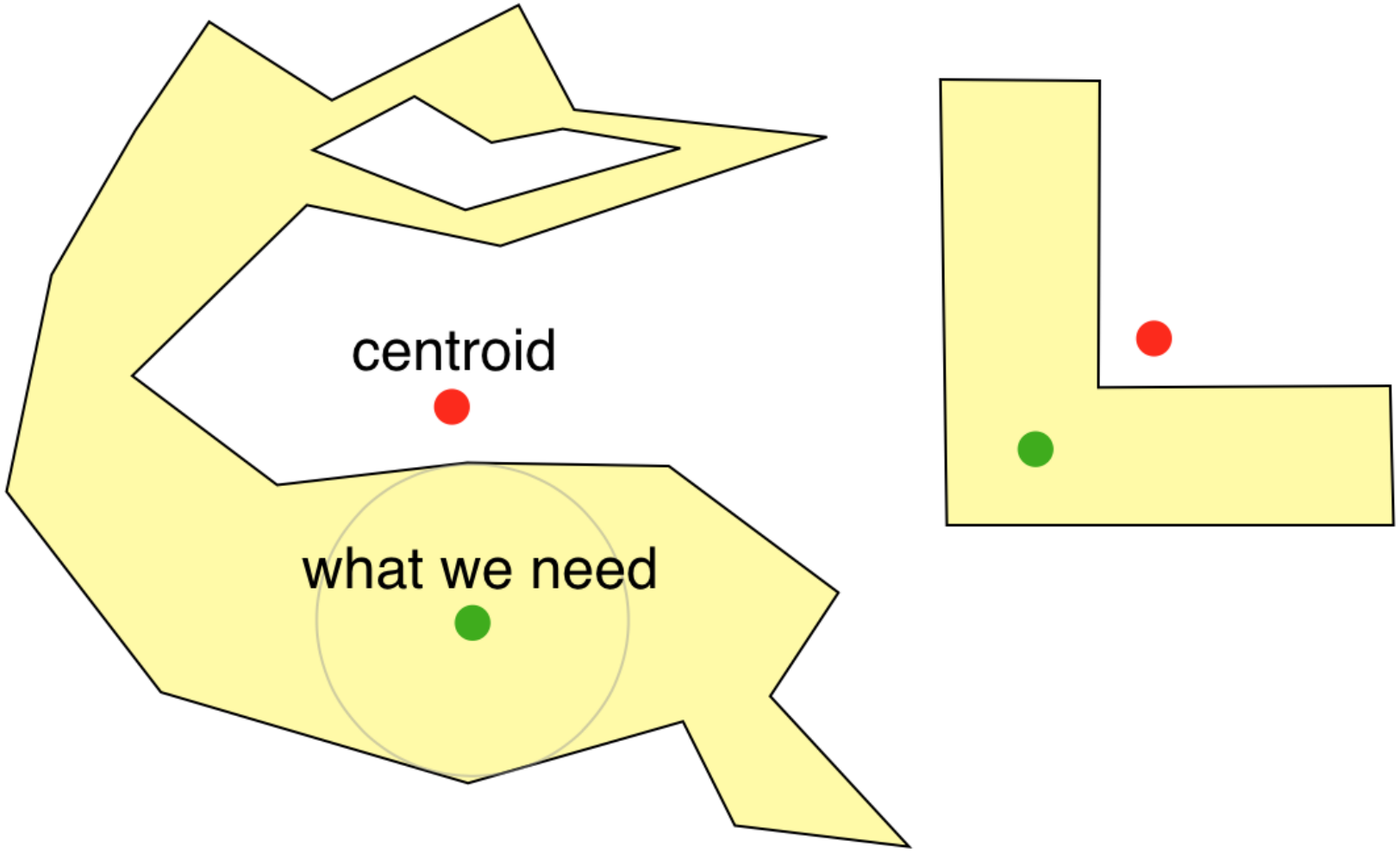
Area


Electoral Wards (9,131)
Without co-terminous boundaries
Electoral
Postal
Administrative
Health
2011 Statistical Building Block
2011 Census
Other
Eurostat
Wales
Scotland
England
UK
Northern Ireland
England & Wales
GB
Local Authority Districts
Experimental
Major Towns and Cities (112)
Unit Postcodes (1,743,604)
Postcode Sectors (11,104)
Postcode Districts (2,960)
Postcode Areas (121)
Electoral Wards (852)
Communities (870)
Unitary Authorities (22)
Combined Authorities (9)
Inner and Outer London (2)
London Boroughs (33)
Metropolitan Districts (36)
Metropolitan Counties (6)
Non-metropolitan Districts (201)
Counties (27)
Unitary Authorities (56)
Council Areas (32)
Local Government Districts (11)
Regions (9)
Civil Parishes (10,459)
Cancer Registries (9)
NHS England Regions (4)
NHS England Region and Local Offices (14)
Public Health England Regions (4)
Cancer Networks (2)
Health Boards (14)
Local Health Boards (7)
Integration Authorities (31)
Strategic Clinical Networks (12)
Cancer Alliances (16)
National Cancer Vanguards (3)
Public Health England Centres (9)
Clinical Commissioning Groups (207)
Sustainability and Transformation Partnerships (44)
Health and Social Care Board (1)
Local Commissioning Groups (5)
Super Output Areas, Upper Layer (94)
Super Output Areas, Middle Layer (6,791)
Super Output Areas, Middle Layer (416)
Intermediate Zones (1,279)
Super Output Areas, Lower Layer (32,844)
Super Output Areas, Lower Layer (1,909)
Data Zones (6,976)
Super Output Areas (896)
Output Areas (171,372)
Output Areas (46,331)
Output Areas (10,036)
Small Areas (4,537)
Census Merged Local Authority Districts (346)
Census Merged Wards (8,546)
Census Merged Counties (35)
Census Detailed Characteristics (866)
Census Local Characteristics (1012)
Settlement 2015 (639)
Built-up Areas (5,830)
Built-up Area sub-divisions (1,826)
Non-Civil Parished Areas (217)
Workplace Zones (60,709)
Police Force Areas (43)
Police Force Area (1)
Police Force Districts (31)
Localities (643)
Northern Ireland Fire and Rescue Service Areas (4)
Northern Ireland Fire and Rescue Service (1)
Scottish Fire and Rescue Service (1)
Scottish Fire and Rescue Service Delivery Areas (3)
Community Safety Partnerships (315)
Fire and Rescue Authorities (48)
Registration Districts (175)
Registration Sub-Districts (175)
Local Resilience Forums (42)
Travel to Work Areas (228)
National Parks (15)
Island Groups (57)
Enterprise Regions (8)
LEP – overlapping part (15)
LEP – non overlapping part (18)
Enterprise Zones (48)
Local Enterprise Partnerships (38)
Primary Urban Areas (56)
Waste Authorities (9)
Development Corporations (4)
Regional Transport Partnerships (7)
Community Justice Authorities (8)
Scottish Police Divisions (13)
Settlements (516)
Regeneration Outcome Areas – Local Areas (100)
Urban Regeneration Companies (6)
Highlands and Islands Enterprise (8)
Broad Rental Market Areas (18)
National Assembly Economic Regions (4)
OCEILs (4)
Strategic Regeneration Sub-areas (2)
Spatial Plan Sub-areas (3)
Agricultural Small Areas (335)
Transport Consortia Areas (4)
Strategic Regeneration Areas (7)
Spatial Plan Areas (6)
Agricultural Regions (7)
Communities First Areas (52)
LAU2 Areas (10,126)
LAU1 Areas (415)
NUTS 3 Areas (173)
NUTS 2 Areas (40)
NUTS 1 Areas (12)
London Assembly Constituencies (14)
National Assembly for Wales Constituencies (40)
Westminster Parliamentary Constituencies (650)
Scottish Parliamentary Constituencies (73)
District Electoral Areas (80)
Northern Ireland Assembly Constituencies (18)
National Assembly for Wales Electoral Regions (5)
European Electoral Regions (12)
Scottish Parliamentary Regions (8)

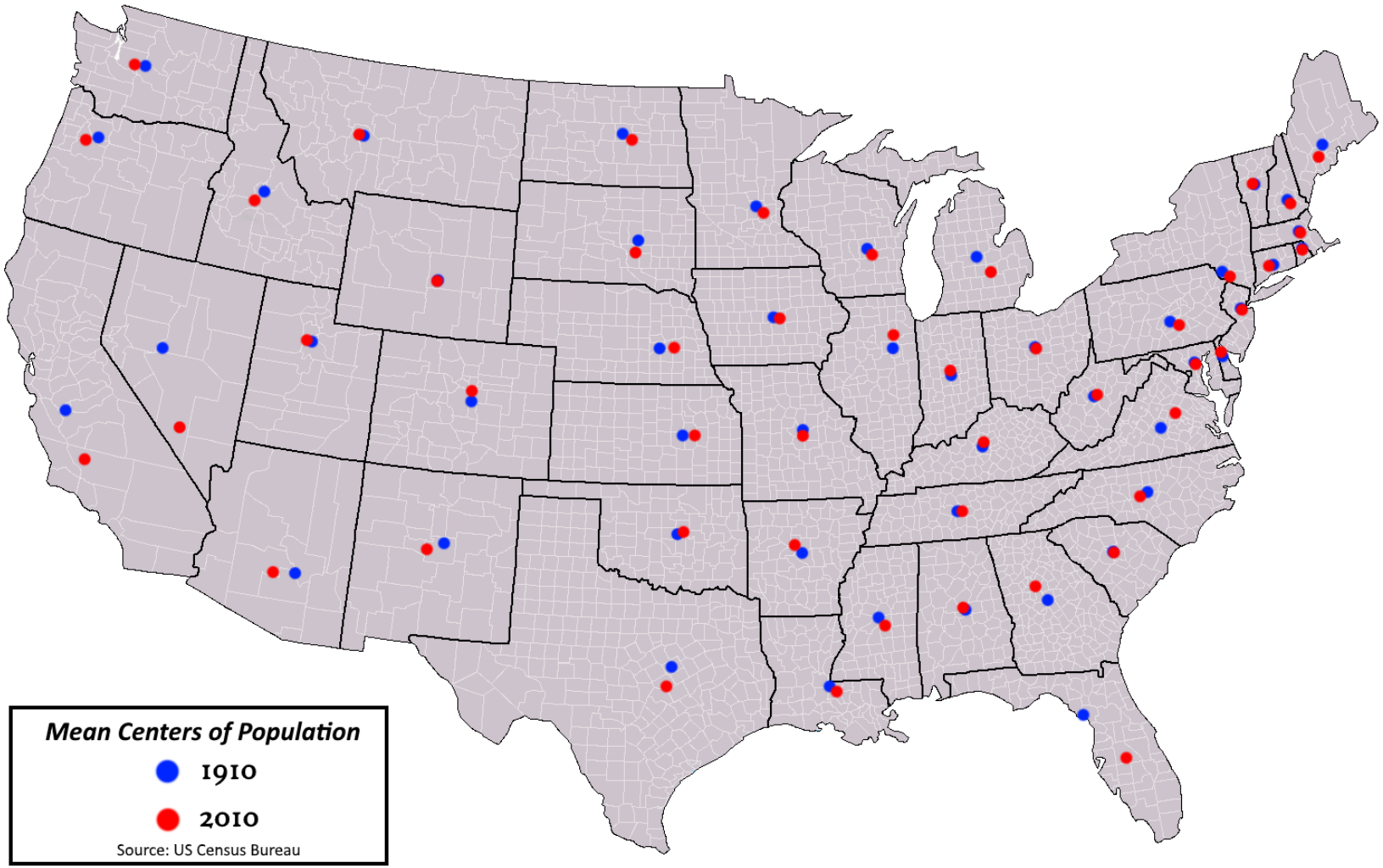
Shape

- 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

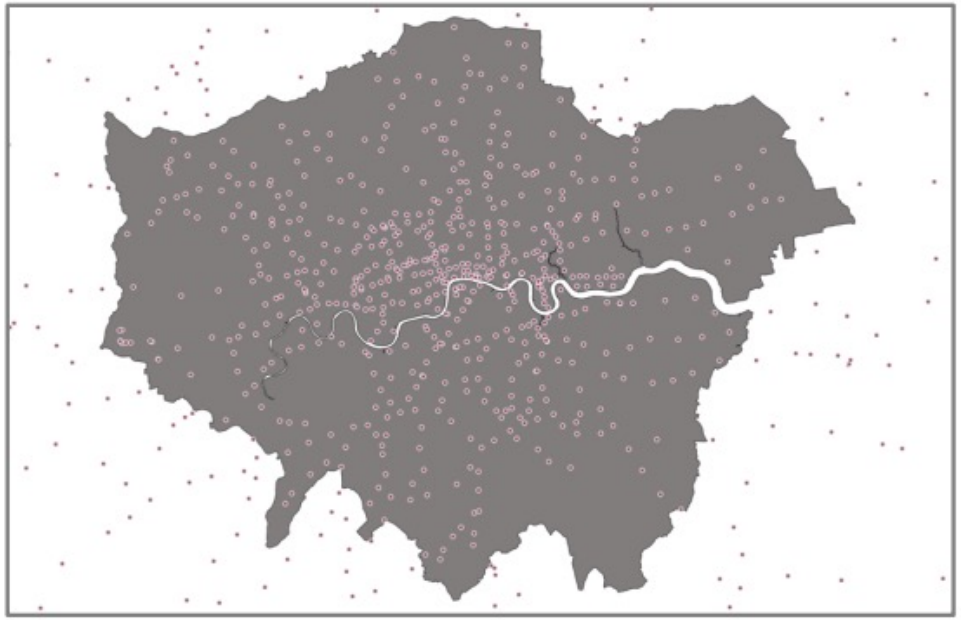

Mean Centers of Population
1910
2010
Source: US Census Bureau

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	
Touches A touches B	
Overlaps A and B have multiple points in common	
Contains A contains B	
Disjoint A shares nothing with B	
Covers A covers B (or vice versa)	
Crosses A and B have at least one point in common	

Spatial relationships

- There is some spatial mathemathics 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`

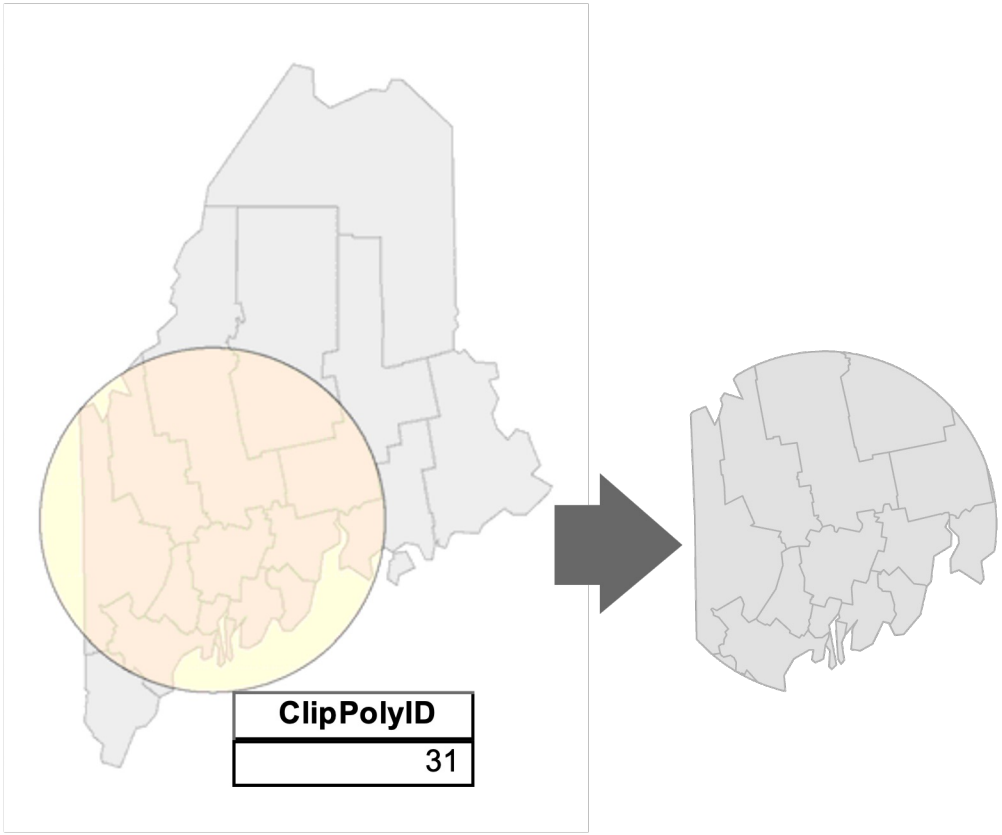
Spatial analysis

`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

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

Vector operations

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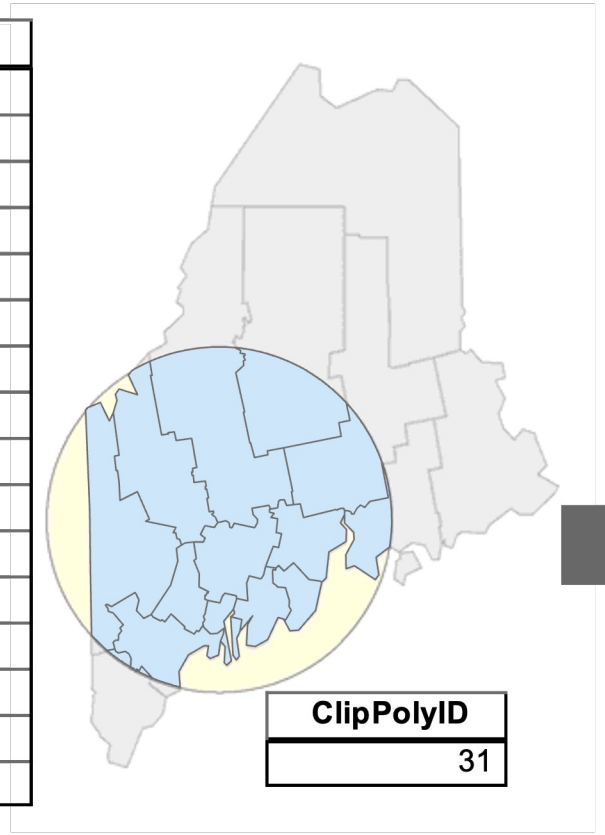

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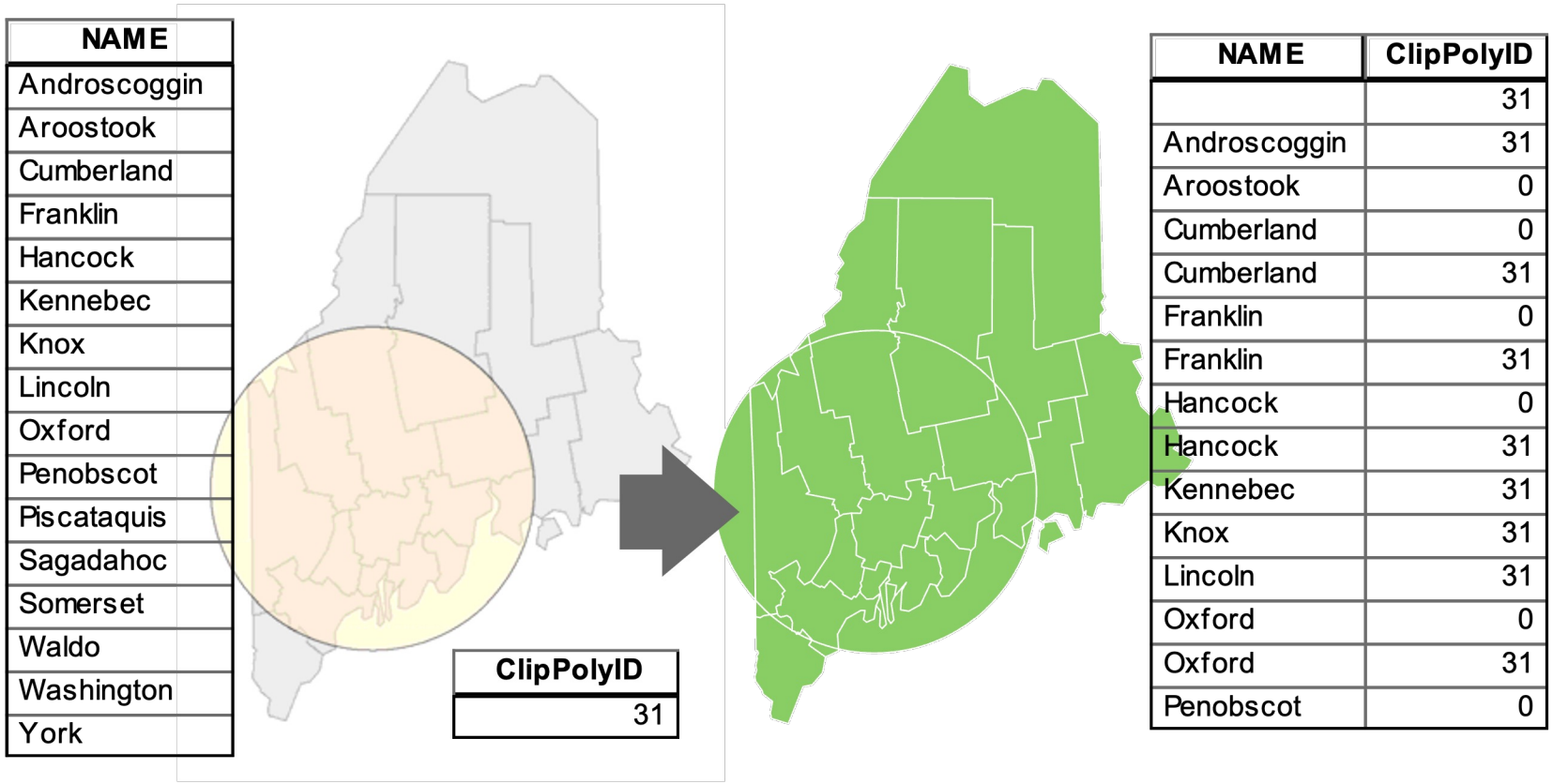
Vector operations



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31

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Knox	31
Lincoln	31
Oxford	0
Oxford	31
Penobscot	0

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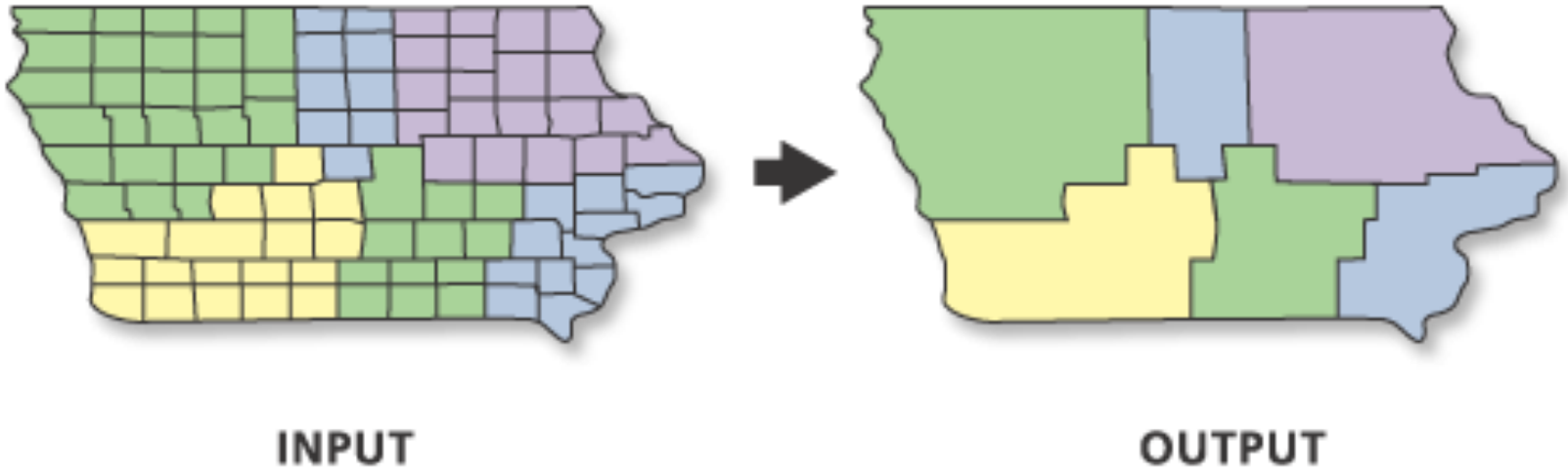
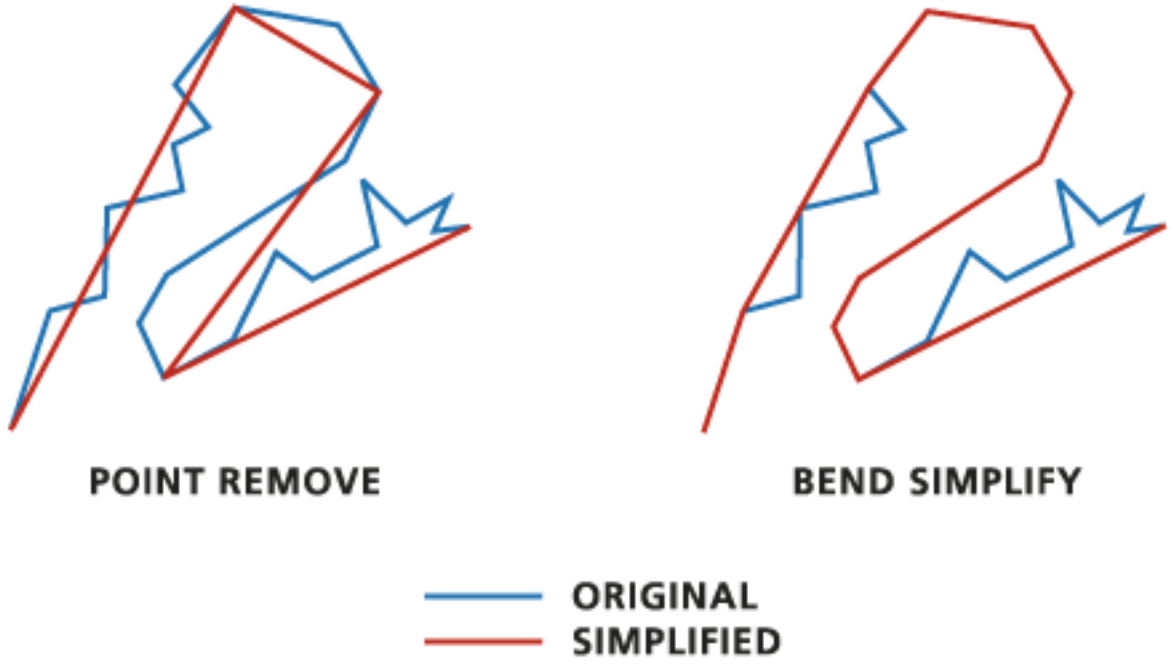
Vector operations - Dissolve



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

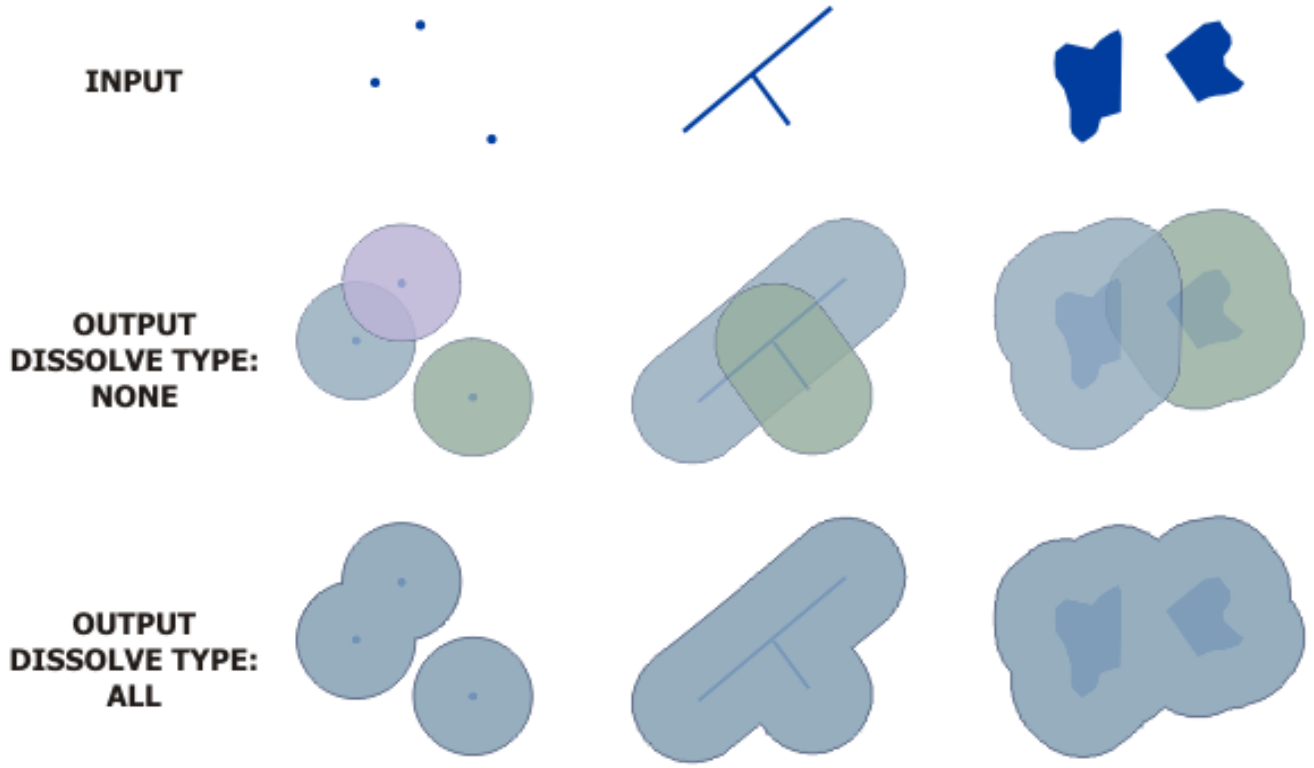
Vector operations - Simplify



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

Vector operations - Simplify

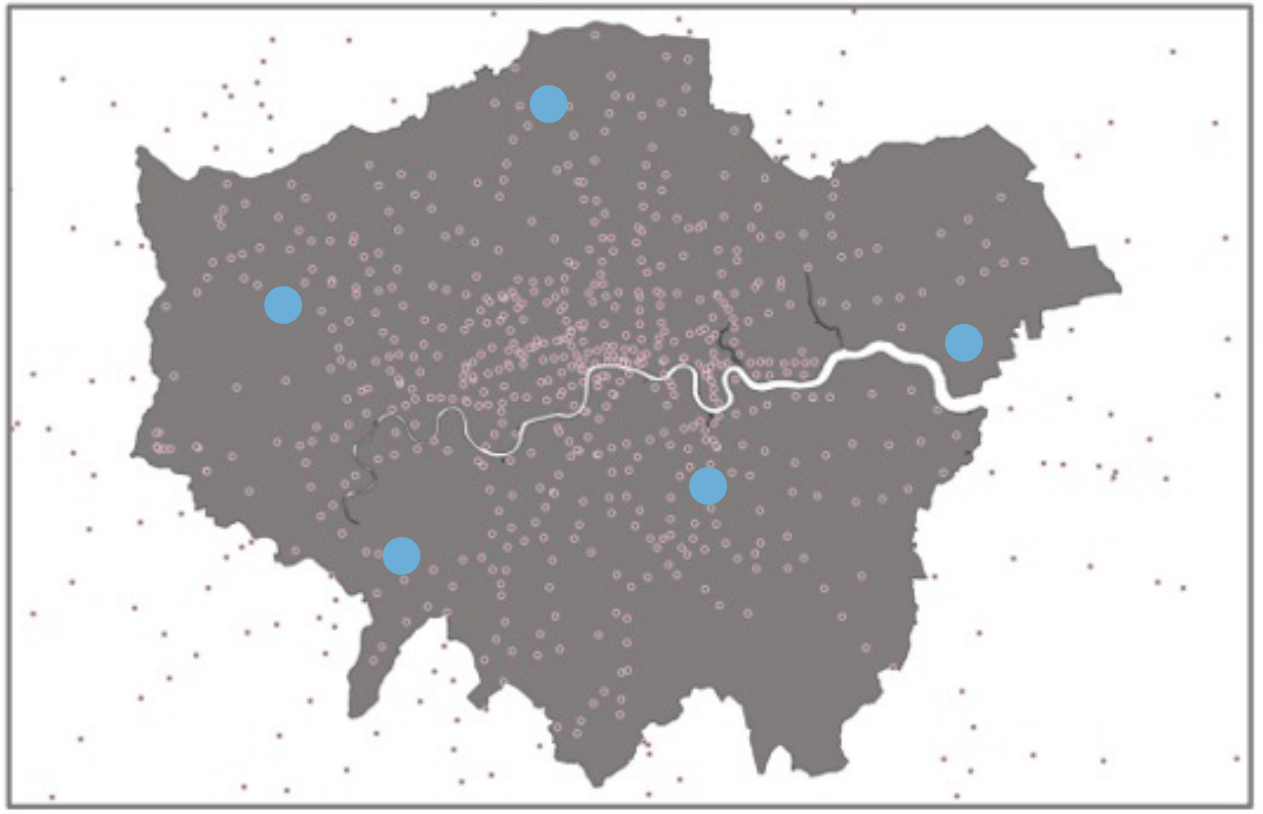
Vector operations - Buffer



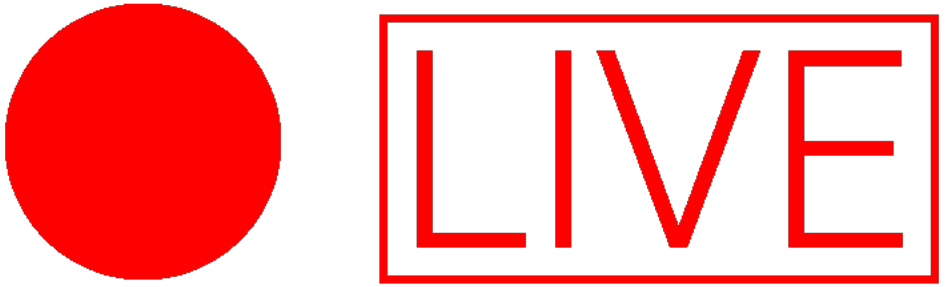
ESRI. 2021. Buffer. [online]
https://pro.arcgis.com/en/pro-app/latest/tool-reference/analysis/buffer.htm

Vector operations – Spatial query

Vector operations – Attribute query



RStudio



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.

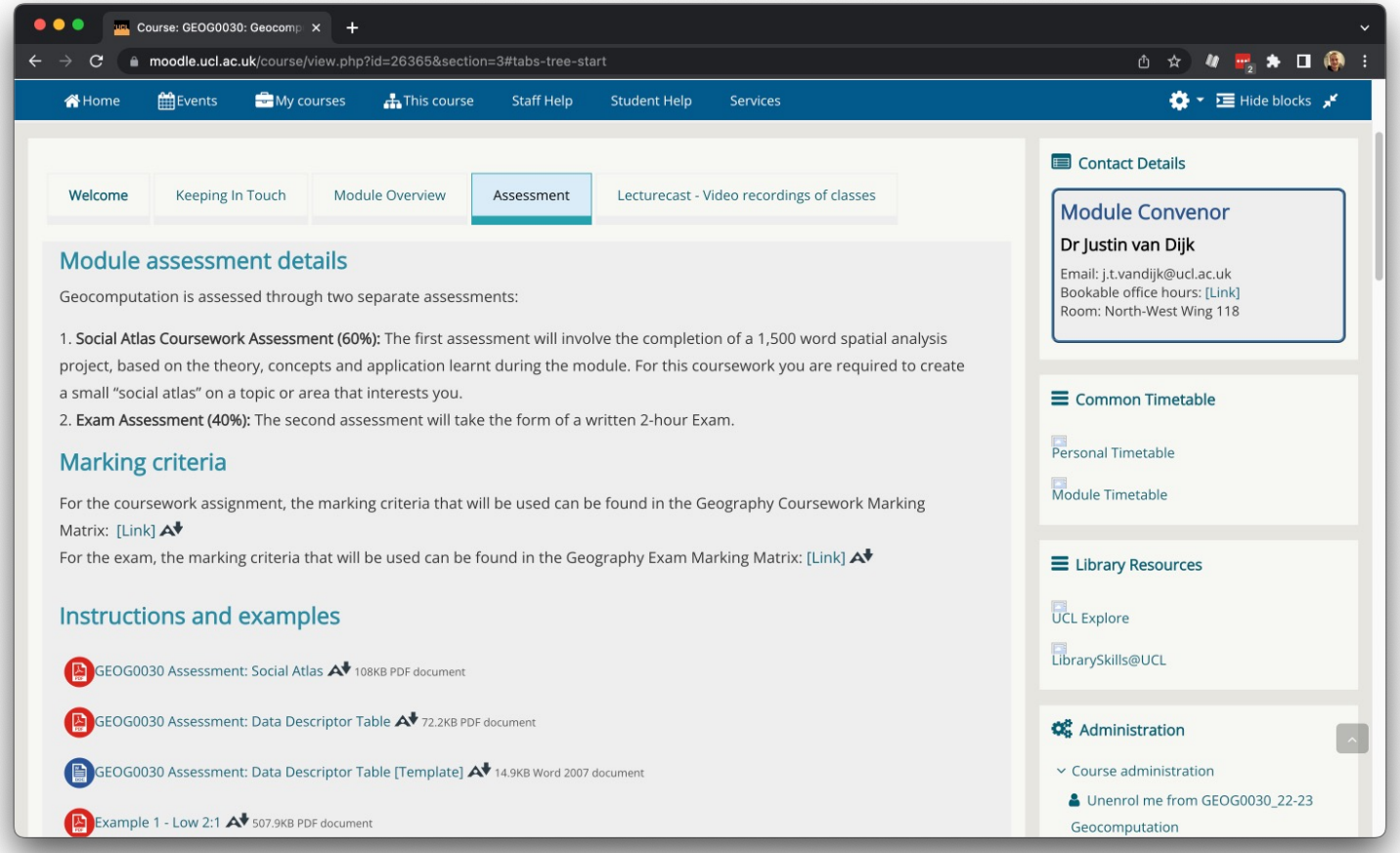
Assessment

- 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 24 2023.
- On Moodle: guidance as well as examples.

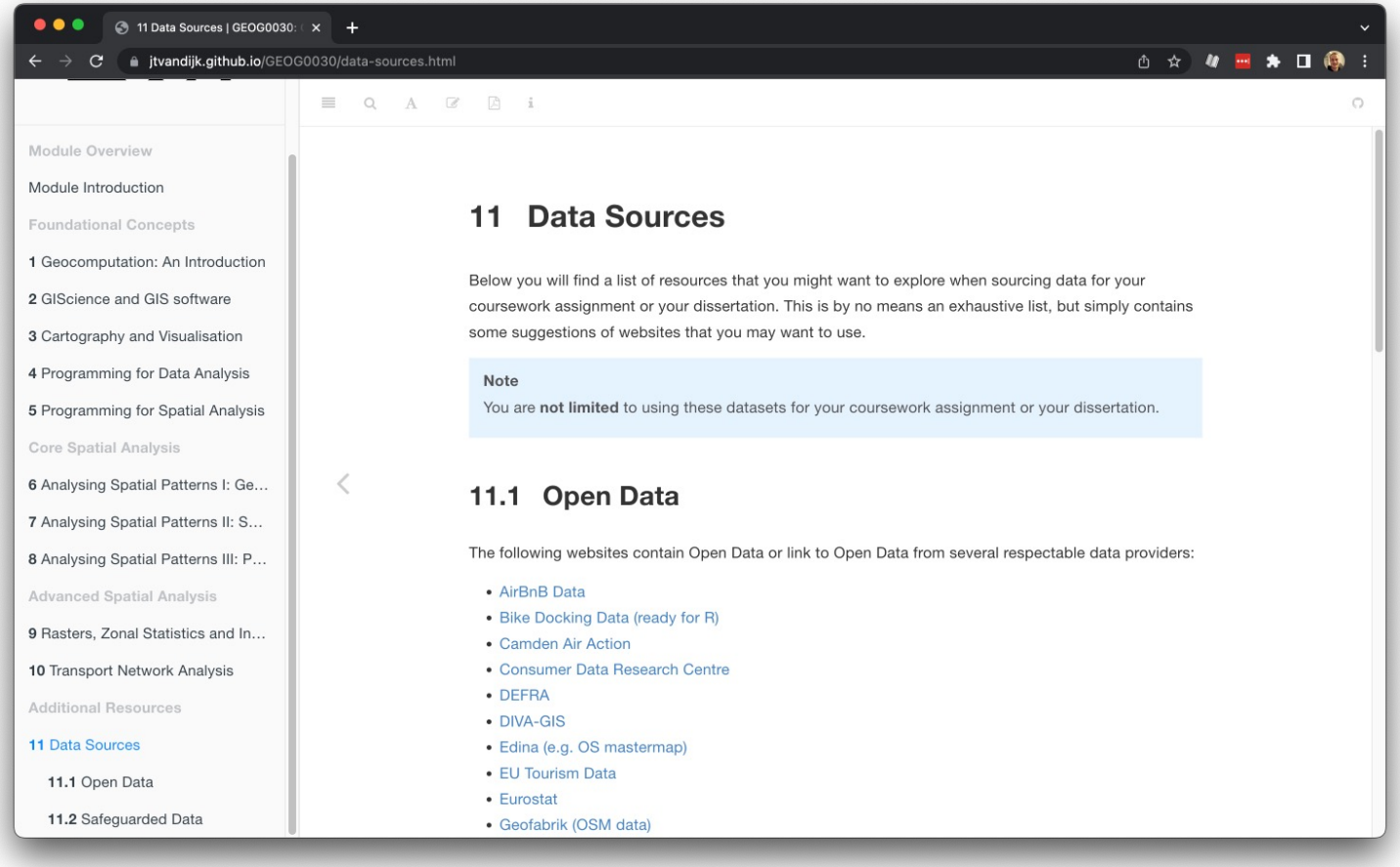
Assessment

- 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”, “COVID19 impact across 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.
- Data from at least three different data sources.

Assessment


Course: GEOG0030: Geocomp
moodle.ucl.ac.uk/course/view.php?id=26365&section=3#tabs-tree-start
Home
Events
My courses
This course
Staff Help
Student Help
Services
Hide blocks
Welcome
Keeping In Touch
Module Overview
Assessment
Lecturecast - Video recordings of classes
Module assessment details
Geocomputation is assessed through two separate assessments:
1. 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.
2. Exam Assessment (40%): The second assessment will take the form of a written 2-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 108KB PDF document
GEOG0030 Assessment: Data Descriptor Table 72.2KB PDF document
GEOG0030 Assessment: Data Descriptor Table [Template] 14.9KB Word 2007 document
Example 1 - Low 2:1 507.9KB PDF document
Contact Details
Module Convenor
Dr Justin van Dijk
Email: j.t.vandijk@ucl.ac.uk
Bookable office hours: [Link]
Room: North-West Wing 118
Common Timetable
Personal Timetable
Module Timetable
Library Resources
UCL Explore
LibrarySkills@UCL
Administration
Course administration
Unenrol me from GEOG0030_22-23 Geocomputation

Assessment


11 Data Sources | GEOG0030:
jtvandijk.github.io/GEOG0030/data-sources.html
Module Overview
Module Introduction
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: Ge…
7 Analysing Spatial Patterns II: S…
8 Analysing Spatial Patterns III: P…
Advanced Spatial Analysis
9 Rasters, Zonal Statistics and In…
10 Transport Network Analysis
Additional Resources
11 Data Sources
11.1 Open Data
11.2 Safeguarded Data
11 Data Sources
Below you will find a list of resources that you might want to explore when sourcing data for your coursework assignment or your dissertation. This is by no means an exhaustive list, but simply contains some suggestions of websites that you may want to use.
Note
You are not limited to using these datasets for your coursework assignment or your dissertation.
11.1 Open Data
The following websites contain Open Data or link to Open Data from several respectable data providers:
AirBnB Data
Bike Docking Data (ready for R)
Camden Air Action
Consumer Data Research Centre
DEFRA
DIVA-GIS
Edina (e.g. OS mastermap)
EU Tourism Data
Eurostat
Geofabrik (OSM data)

Assessment

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

Geocomputation Help Session

- Friday February 24 from 16h00-17h00 in North-West Wing 3.04.
- Bring your own laptop.
- Not mandatory.

Map challenge

Questions

Justin van Dijk

j.t.vandijk@ucl.ac.uk