



UK Data Service

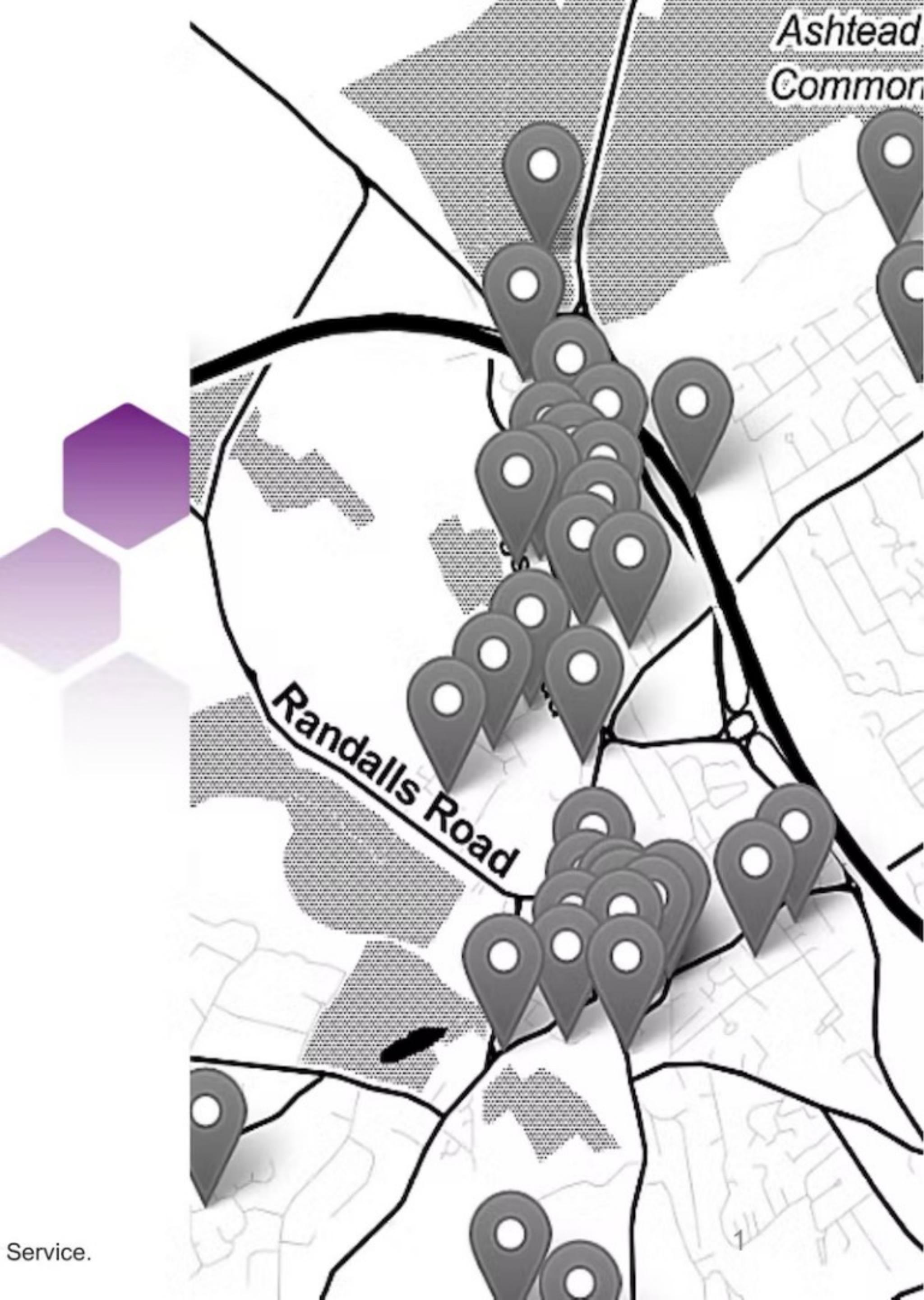
Mapping Crime Data in R:

An Introduction to GIS and Spatial Data

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Economic
and Social
Research Council



Upcoming CSS Events:

- Computational Social Science Drop-in - **14/03/2023**
- An Introduction to Time Series Analysis and Forecasting -
04/04/2023 + 06/04/2023
- How to become a computational social scientist -
18/05/2024
- For the full list of events browse our event page
 - **<https://ukdataservice.ac.uk/training-events/>**



Interaction

- During this workshop you can use the Zoom chat for technical questions or comments (to chat with the facilitator – Emma Green).
- If you want to ask questions in relation to the content of this talk, then you can use the Zoom Q+A function.
- This Workshop will involve several polls, short answers and other interactions where all answers will appear anonymously on the screen. For this, you need to go to menti.com and enter the 8 digit code at the top of the screen .
- Lets test this now!



Instructions

Go to

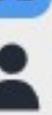
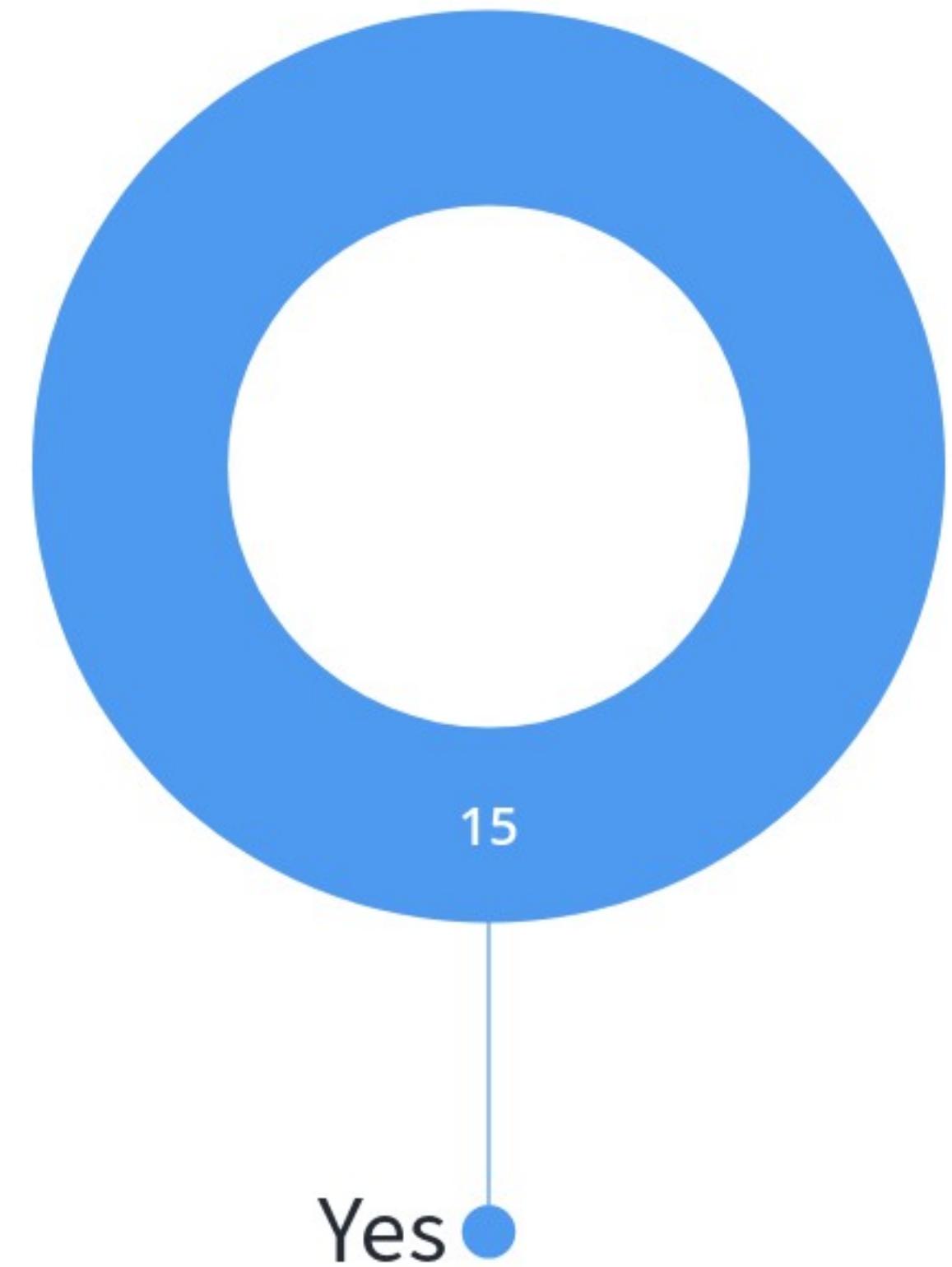
www.menti.com

Enter the code

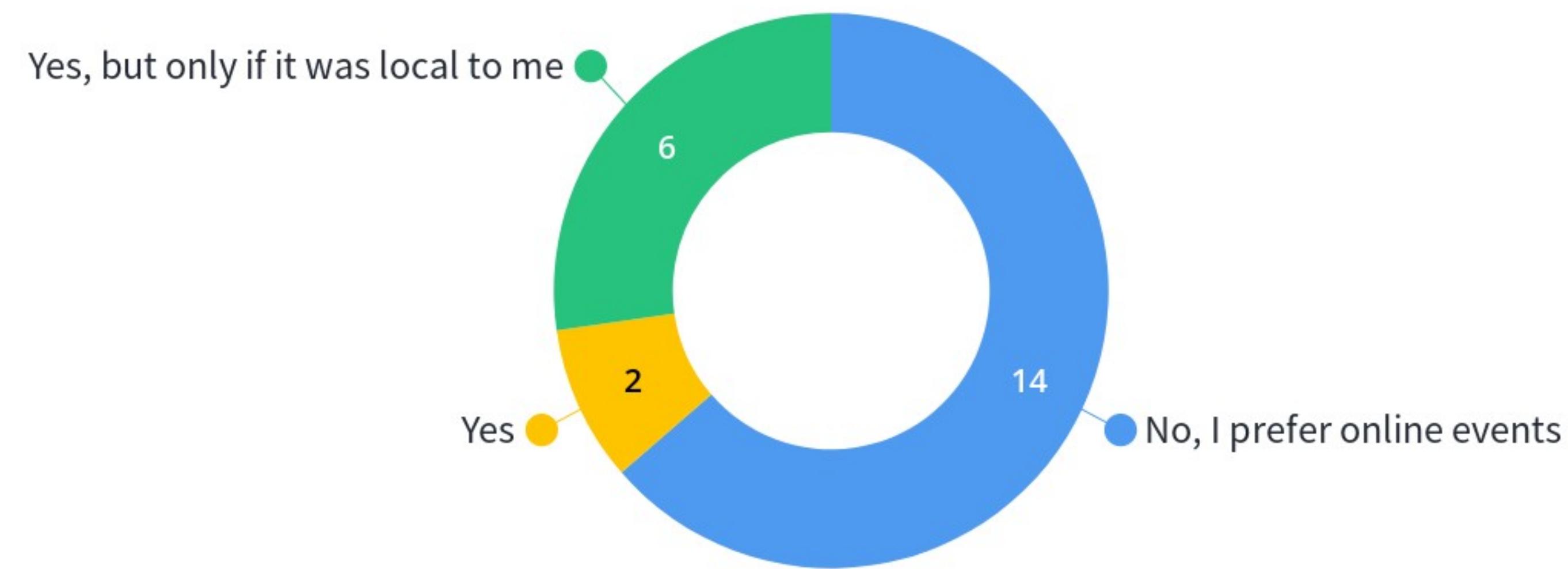


Or use QR code

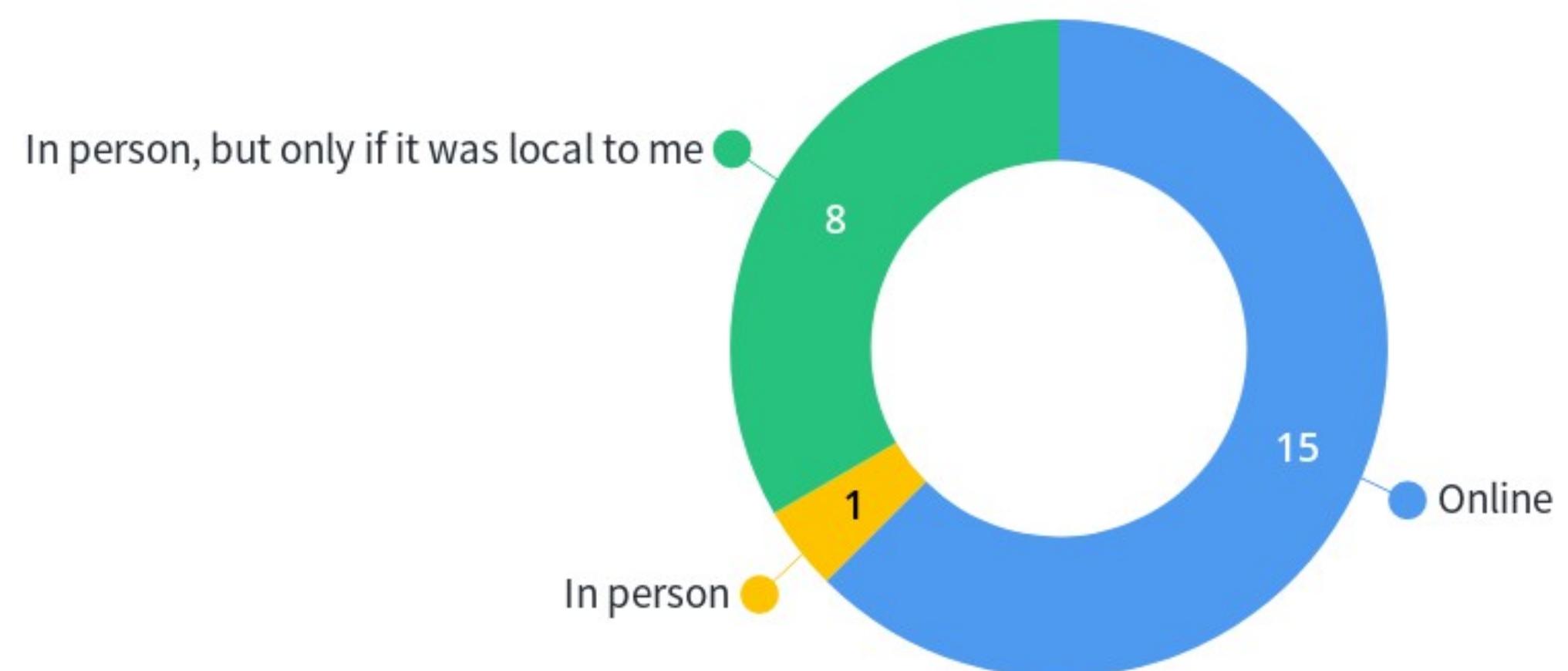
Can you hear me?



Would you have preferred this event to be in-person?



If this event had been a hybrid event (with the option to join in person or online), how would you have attended?



Troubleshooting audio problems

- Check your speaker/headset is plugged in / volume is on.
- Click on audio to change to listening via phone
- This workshop is live on YouTube. We are also recording this workshop and will post it on YouTube (<https://www.youtube.com/user/UKDATASERVICE>)

Workshop Content – March 6th 2023

- What is GIS
- Spatial Data vs Non-Spatial Data
- Different types of maps (reference vs thematic)
- Projection Methods and Coordinate Reference Systems
- Challenges of Mapping Crime Data



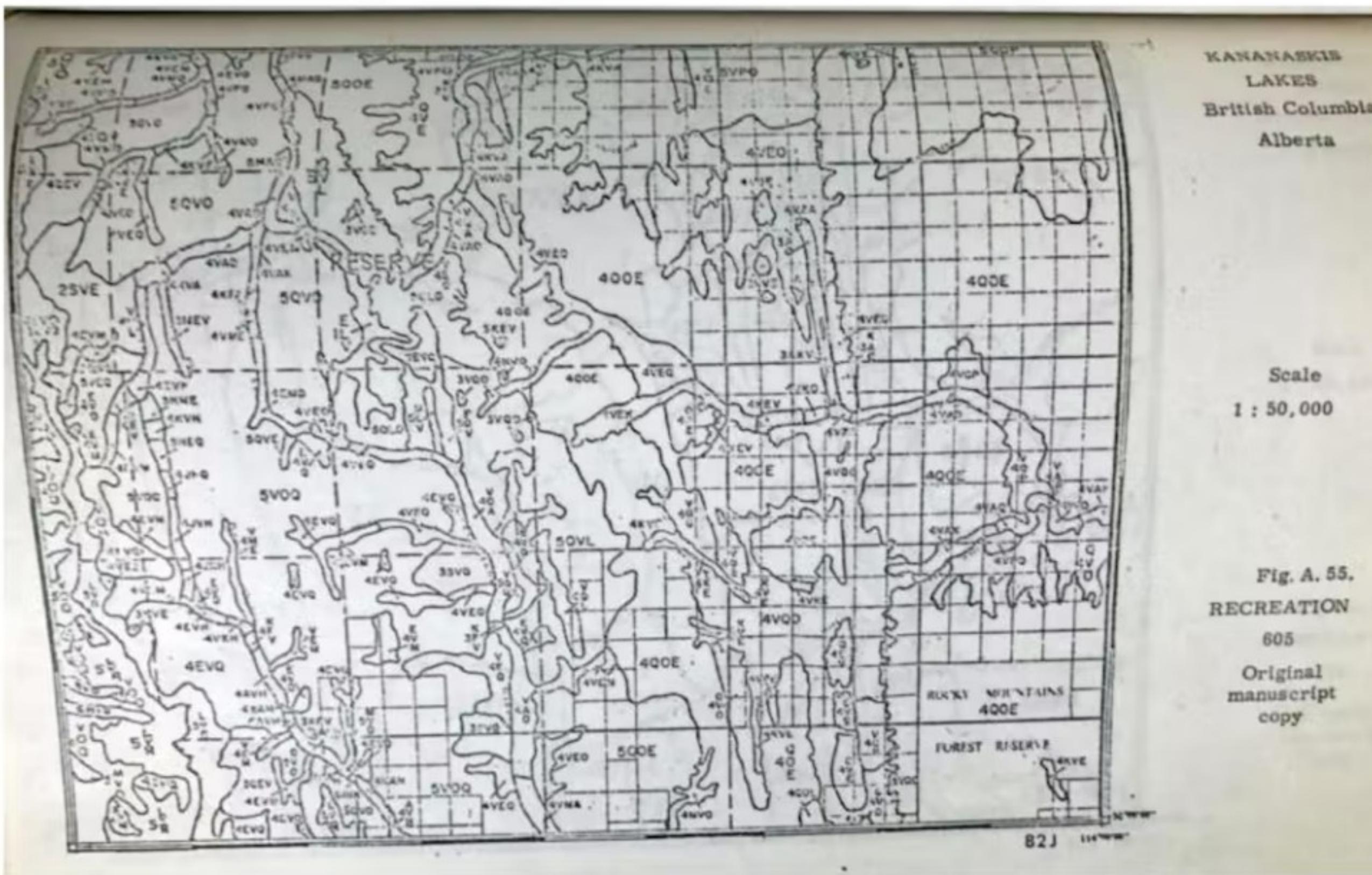
Live Code Demo – March 8th 2023

- Topic 1 – Exploring our crime data
- Topic 2 – Shapefiles
- Topic 3 – Combining census data (crime rate)
- Extra Topic – Interactive maps via Leaflet Package



What is GIS?

- Graphical Information Systems:
 - “computer system for capturing, storing, checking, and displaying data related to positions on Earth’s surface”



Continued.

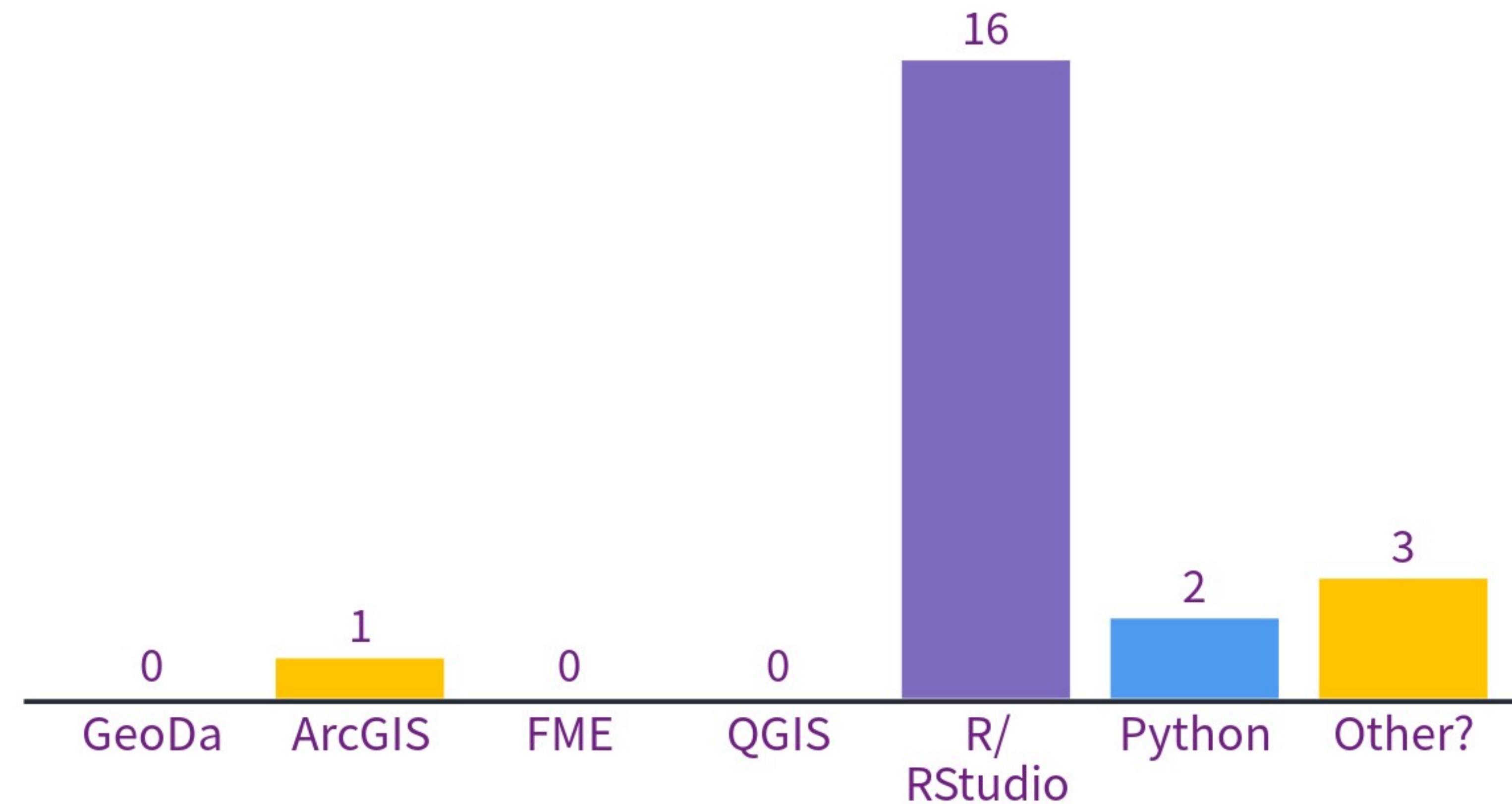
- All data in GIS is ‘georeferenced’ meaning it has both;
 - Attribute (what it is)
 - Location (where it is, a known location)

What software's are available?

- GeoDa,
- ArcGIS,
- FME,
- QGIS,
- R
- ...



What software have you/do you use?



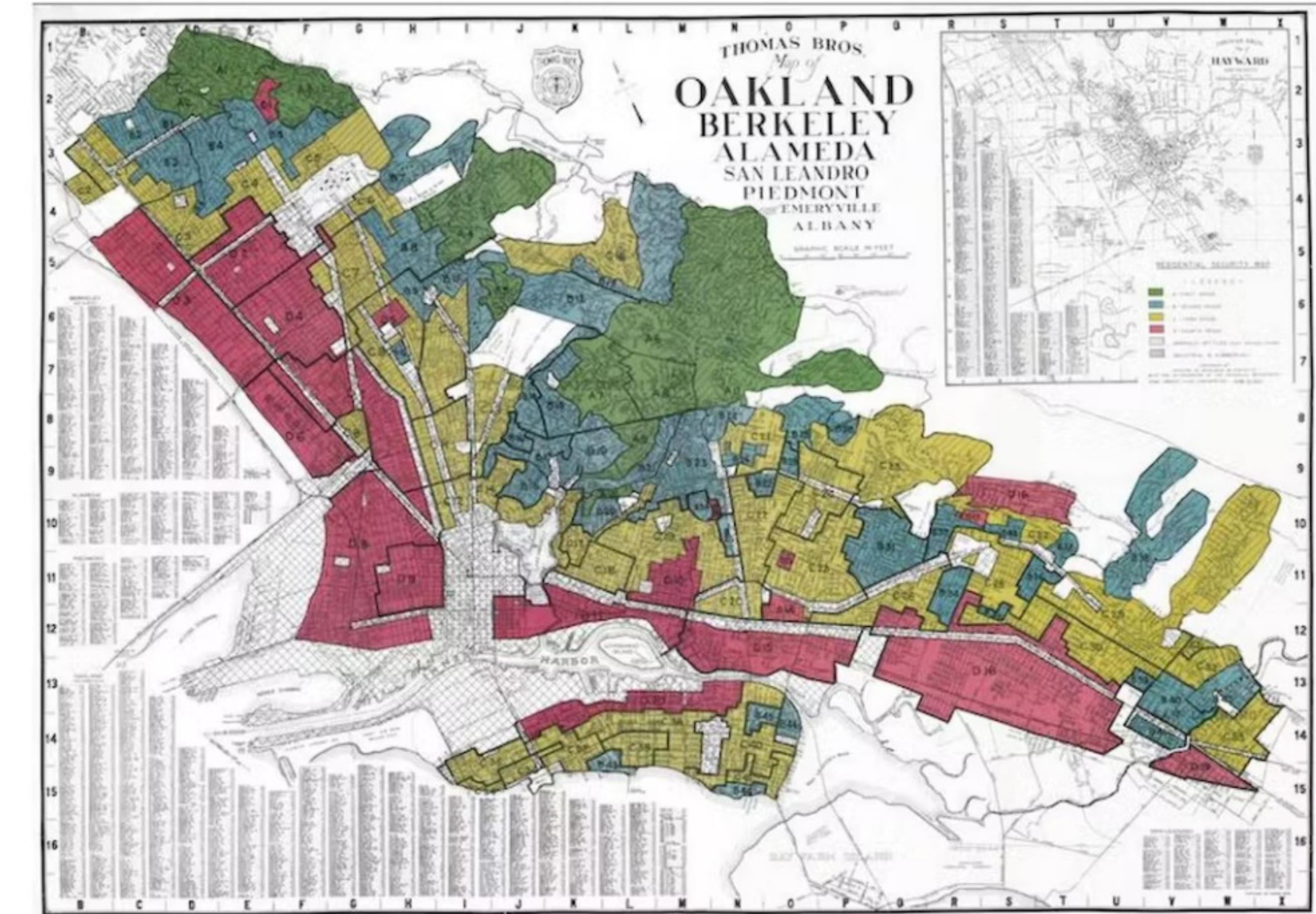
How is GIS used?

1. Identify problems
2. Monitor change
3. Manage and respond to events
4. Perform forecasting
5. Set priorities
6. Understand trends

- Reference: <https://www.esri.com/en-us/what-is-gis/overview#liSwitcher>

'Redlined Maps'

- The history of 'Redlined' maps
- The social effects
- The physical environment



Here are just some of the questions that GIS allows us to explore with crime data.

- Where are the most vulnerable communities located?
- Why do crimes occur in one area and not the other
- How do offenders travel to the crime location?
- Where are there more or less stop and search than we would expect in relation to the distribution of crime?

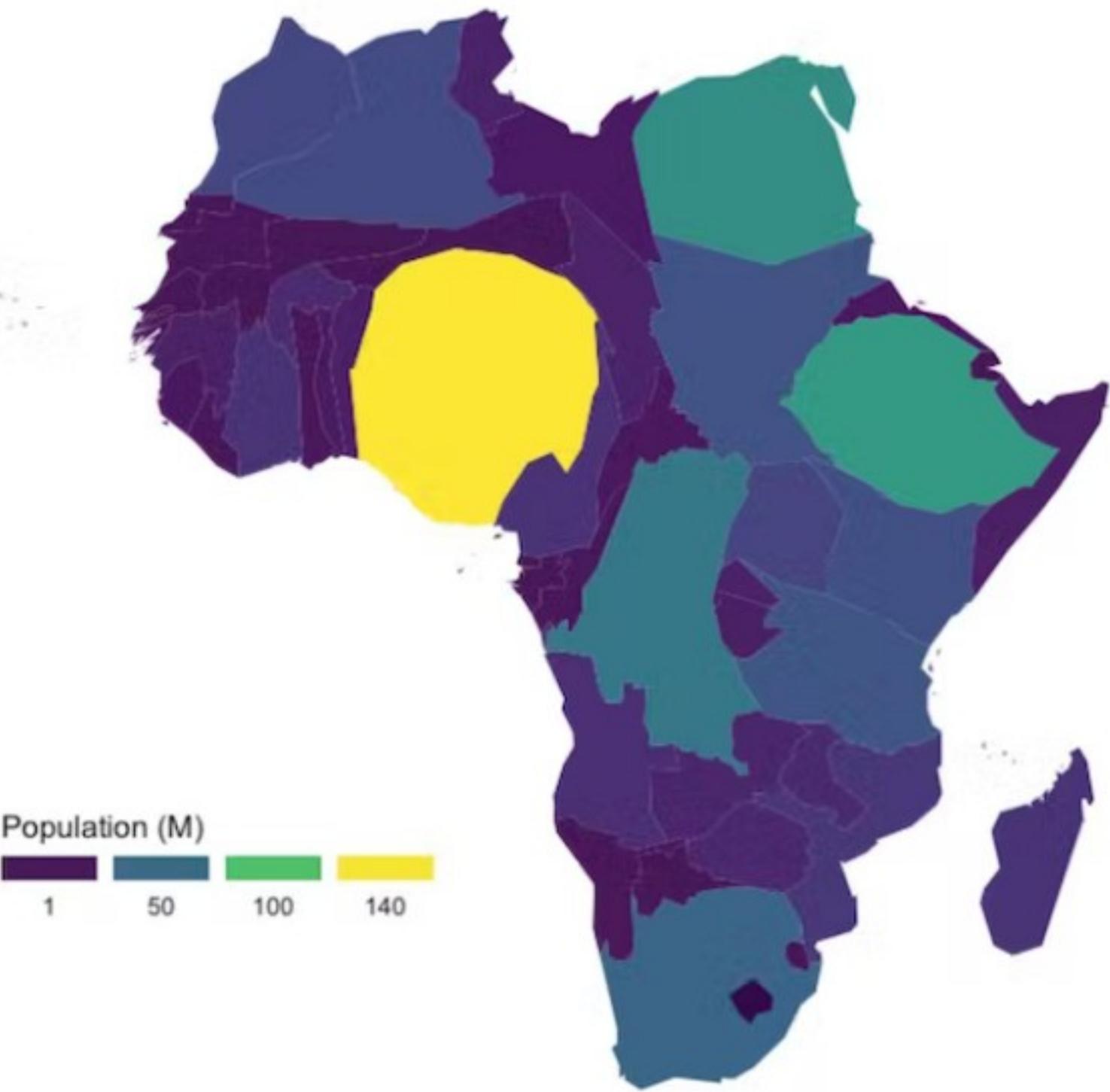
Reference vs Thematic Maps

- Reference Maps: used to communicate location on more static data points
 - To ‘pin point’ data on a map
 - Descriptive
- Thematic Maps: used to highlight a spatial relationship
 - To ‘study a theme’ within a map
 - Explanatory

Reference vs Thematic Maps Continued...

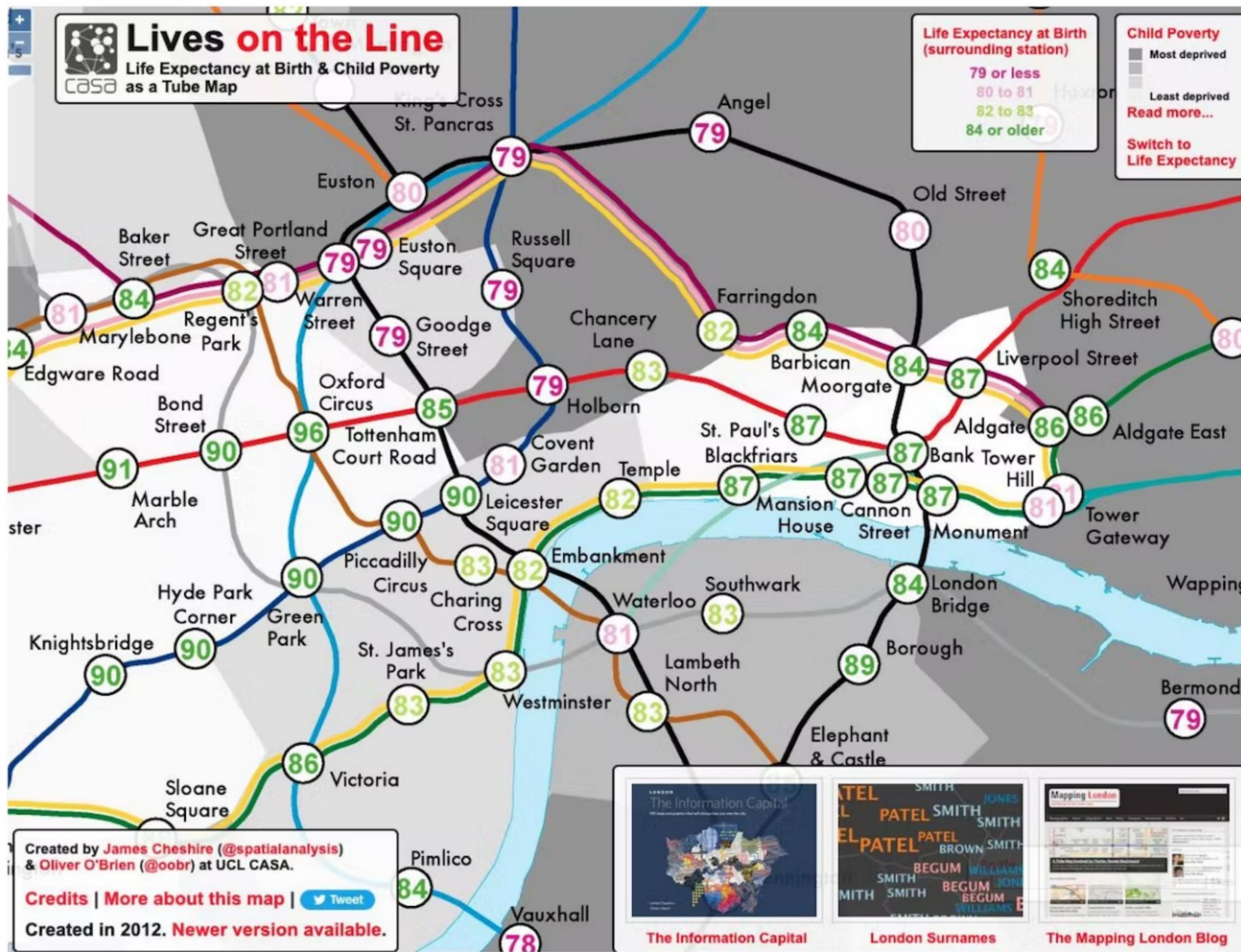


Vs



Tube Map Example

(source = <https://www.crimrxiv.com/pub/slkb1v54/release/1>)



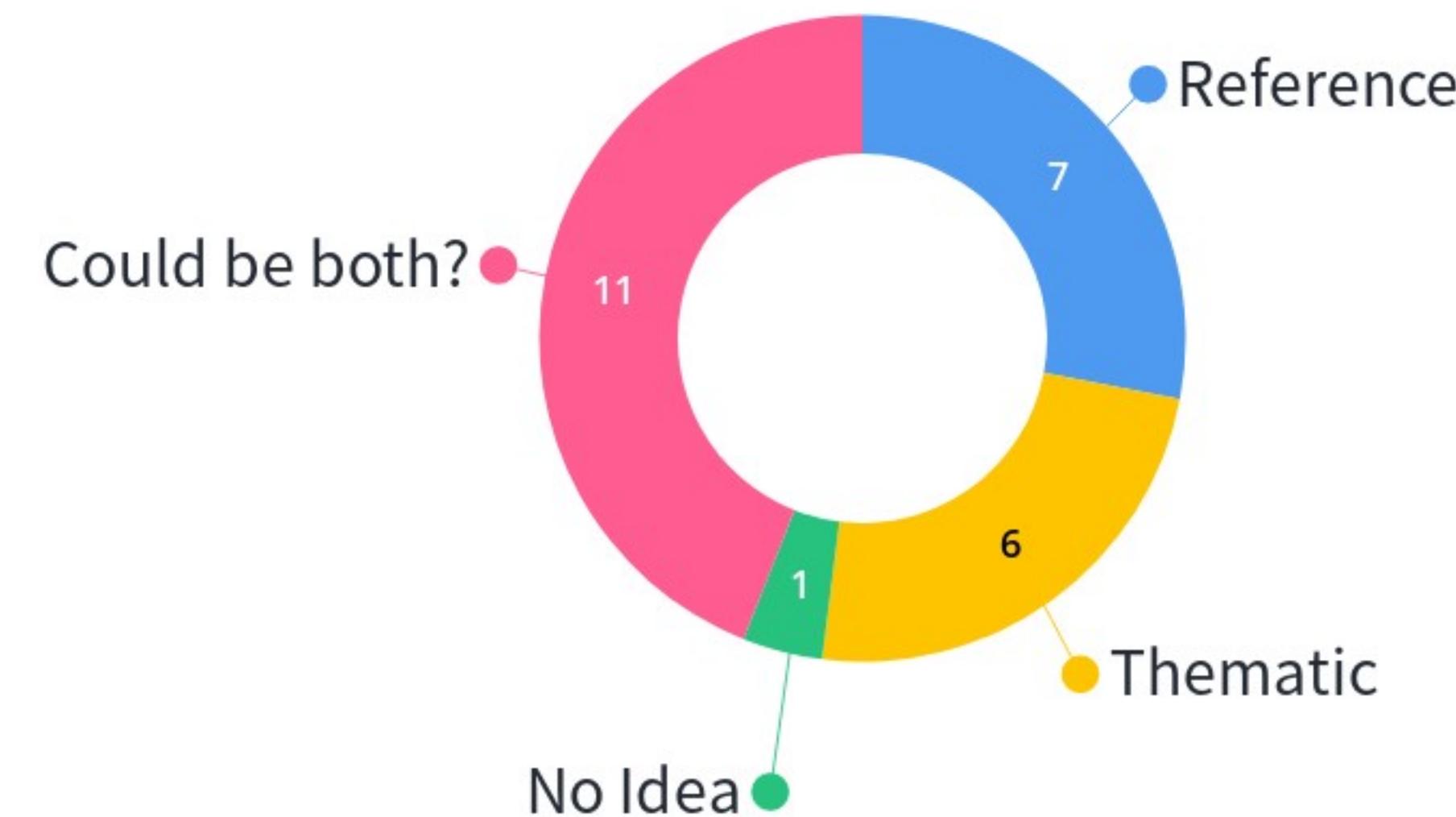
Tube Map Example

- How do we class Tube Maps;
- Reference maps because...
 - They show the location of different tube stations, and the location of each tube line
- Thematic maps because...
 - They can be used to predict life expectancy, poverty and median house prices

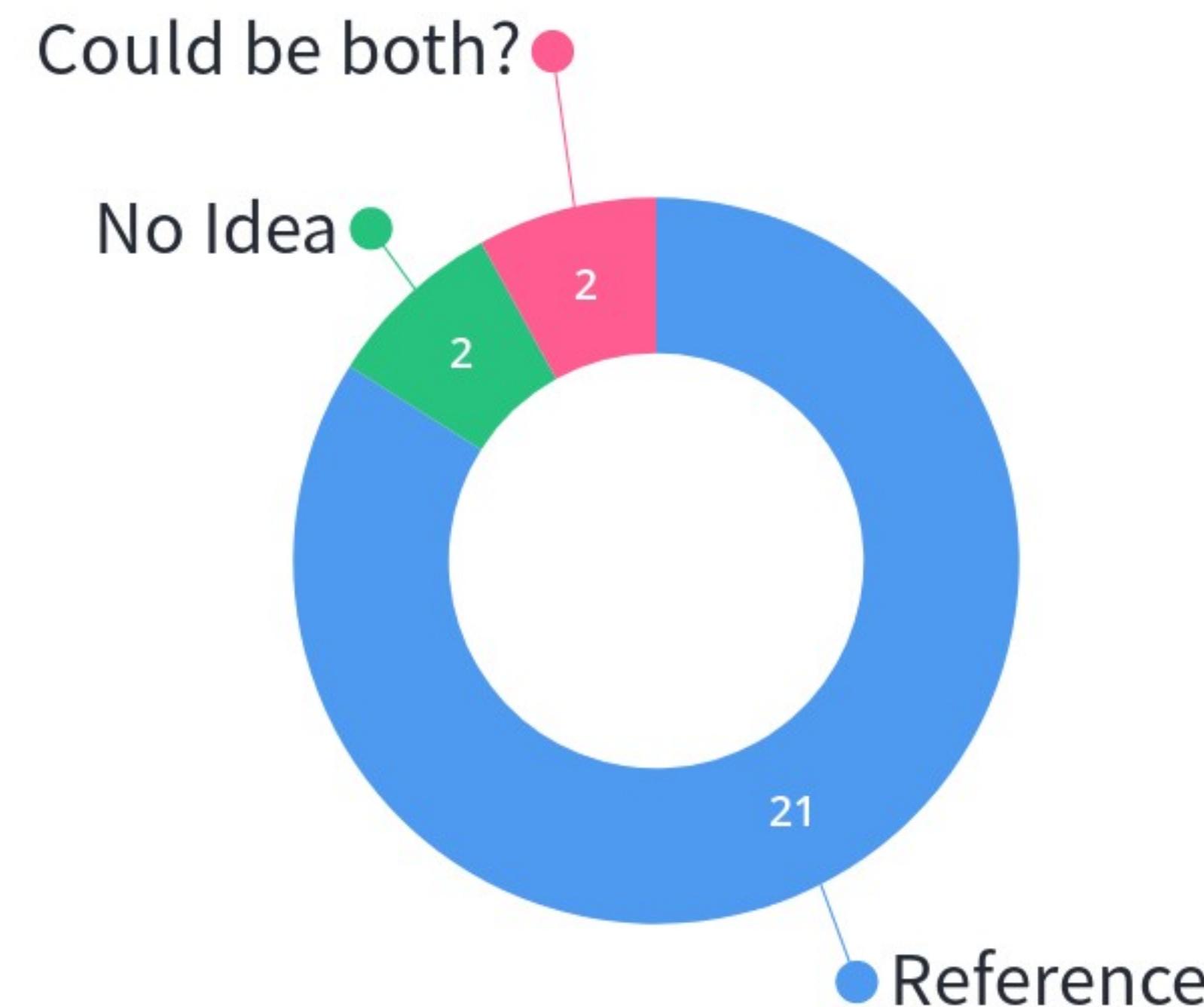
If you're interested you can view the interactive link here;

https://tubecreature.com/#/livesontheline/current/same/U/*/FFTFTF/11.469326848406268/-0.1622/51.5142/

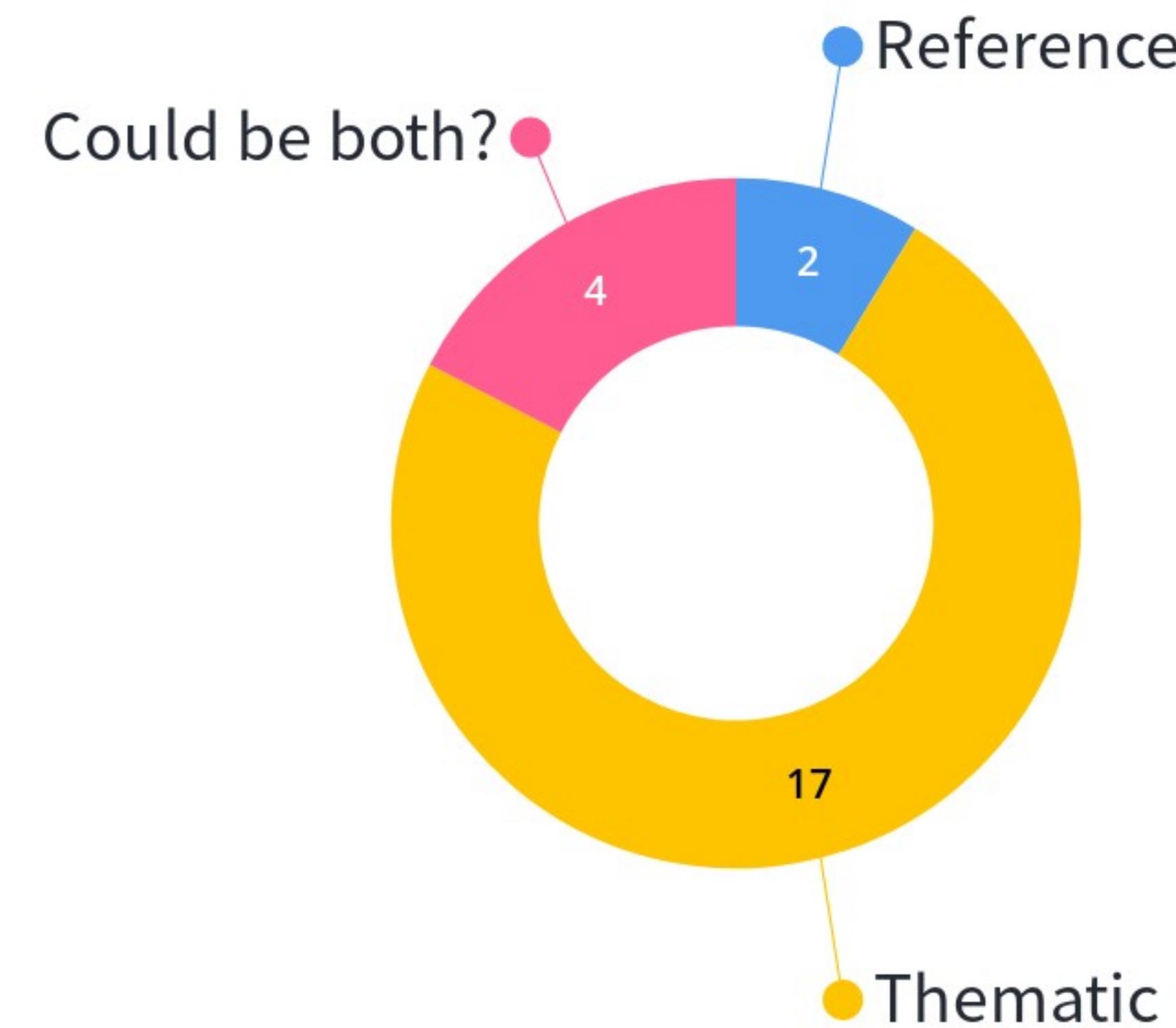
The visualisation of road networks to improve road safety measures are a type of...



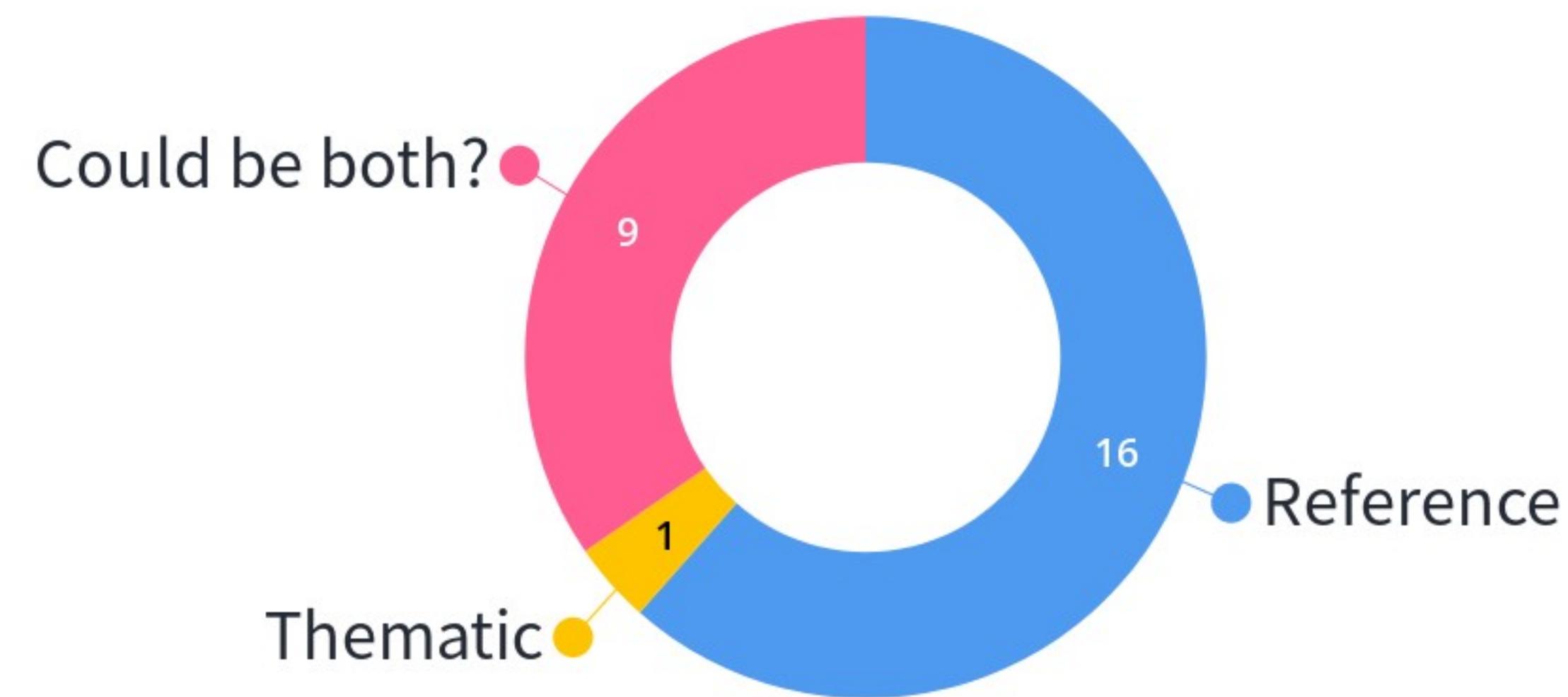
The visualisation of the earths surface, showing its elevation, is a type of map



Creating a map that shows the location of different species of birds in a particular area is an example of a _ map



Navigation tools, such as Google Maps, can be classed as



To sum up

- All though maps falls broadly into two categories, there are ways in which these types of map overlap or share similarities
- Almost every thematic maps is also a reference map, but not every reference map is a thematic map
- The decision is up to you, it is not entirely necessary to define these in your work but it is important to now what type of map you want to make as these can be affected by the data you have

Would you be able to give examples of any other types of maps that share both reference and thematic properties?

Heat maps

Kriging Maps

weather maps

Heatmap

Clustering

Education levels?

Maps showing what areas are farmlands, forests, etc.

income map

Hot spot map

Would you be able to give examples of any other types of maps that share both reference and thematic properties?

World map colour coded by population size

Graduated Symbol Map

social status

Job maps

cosmos maps

What is Spatial Data?

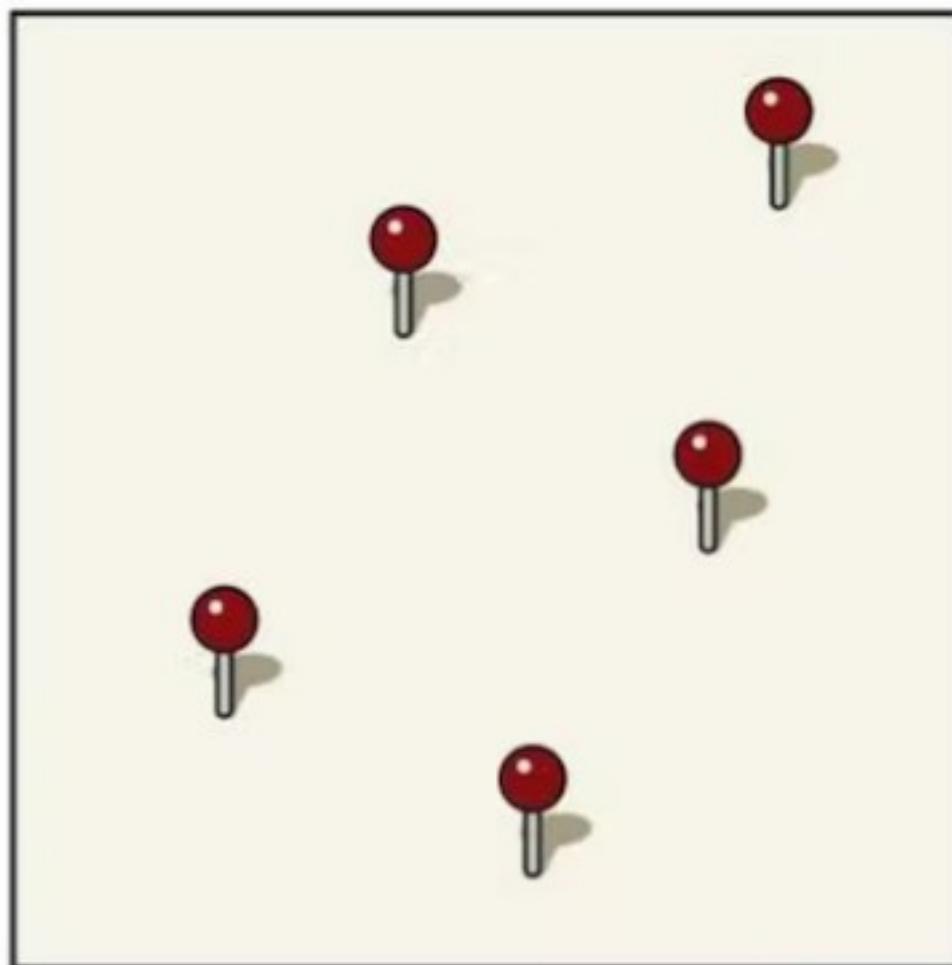
- Spatial data (or geospatial data) is a data frame that contains information about a specific location, which can be analysed to better understand that location.
- GIS enables this spatial data to be processed and analysed.
- Two types: Vector and Raster

Break

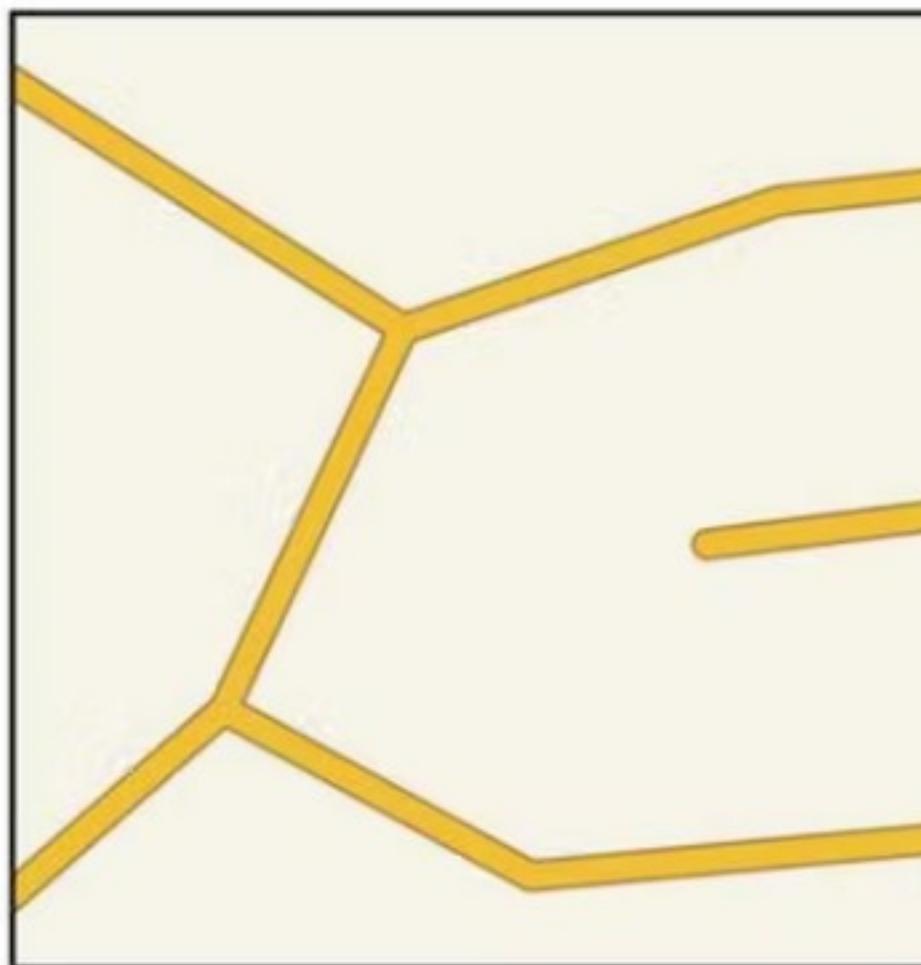


Vector Data

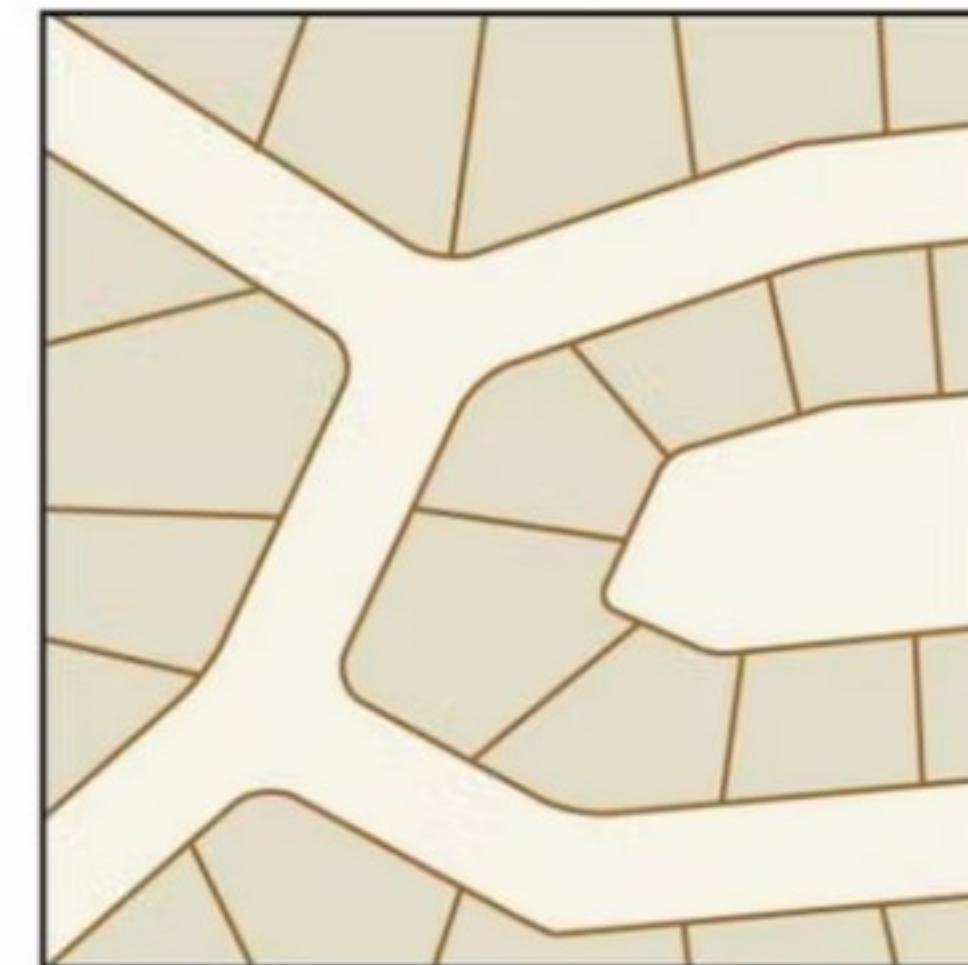
- Vector Data (points, lines and polygons)



Points



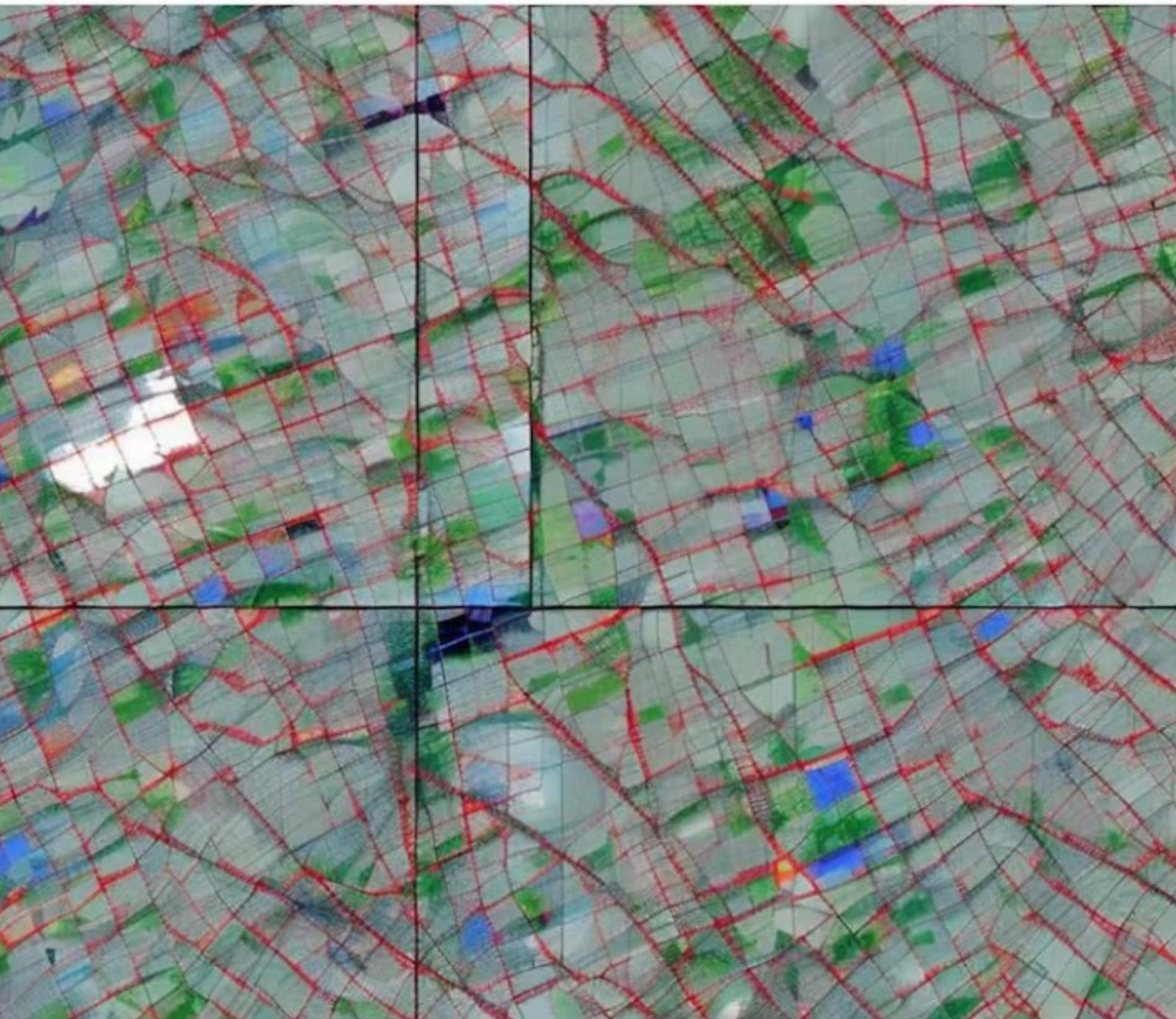
Lines



Polygons

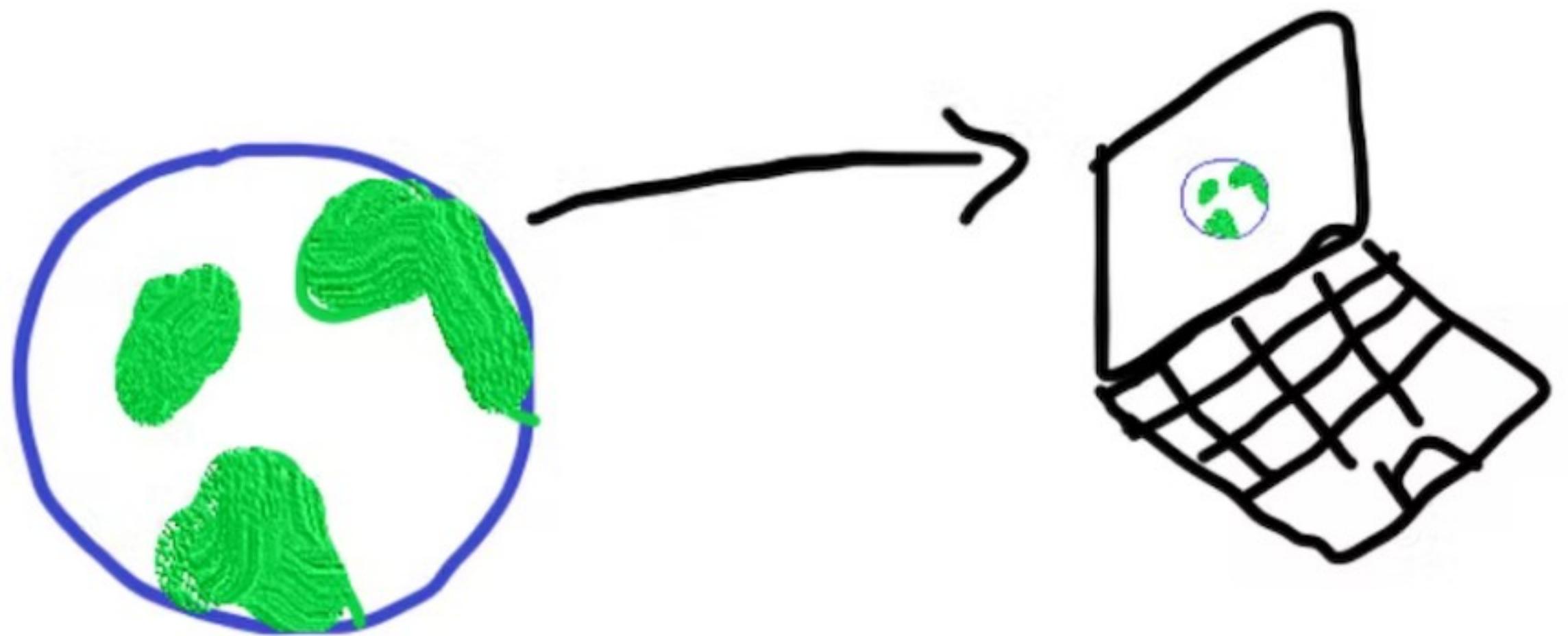
Raster Data

- Imagery or satellite data that are formed from a grid of pixels.

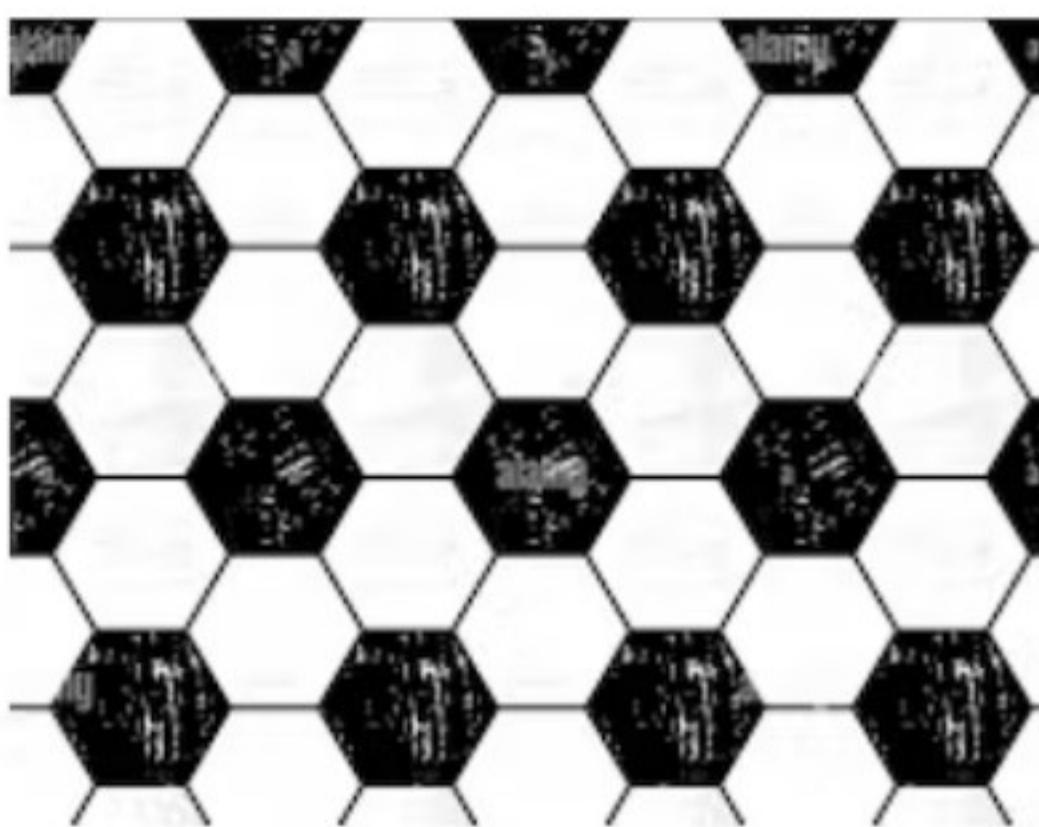
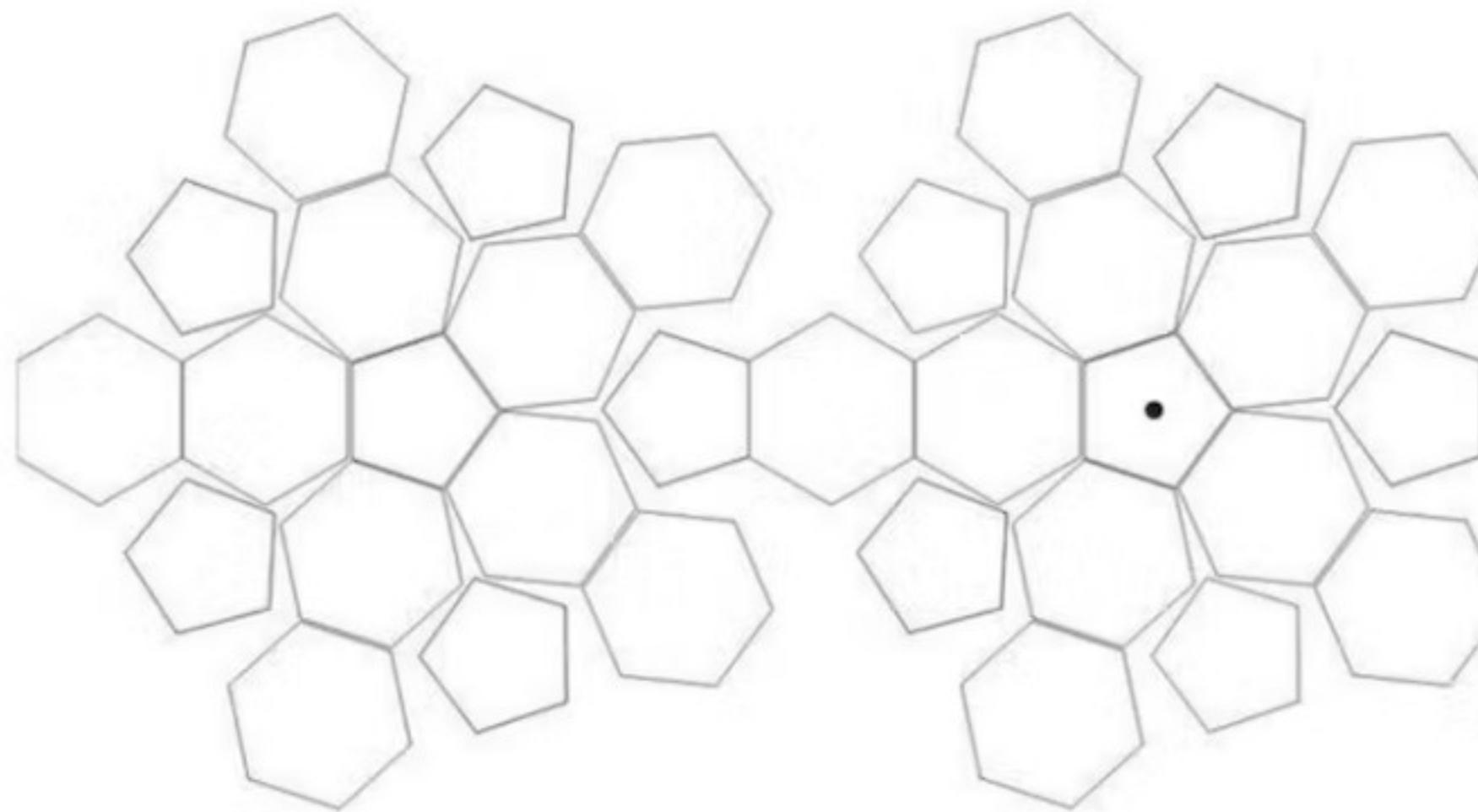
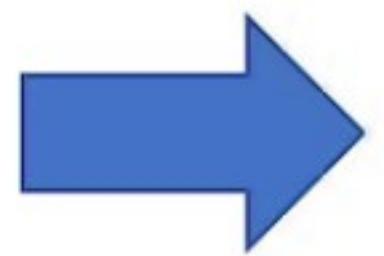


Projection Methods

- Moving from the 3D to the 2D



Football Example

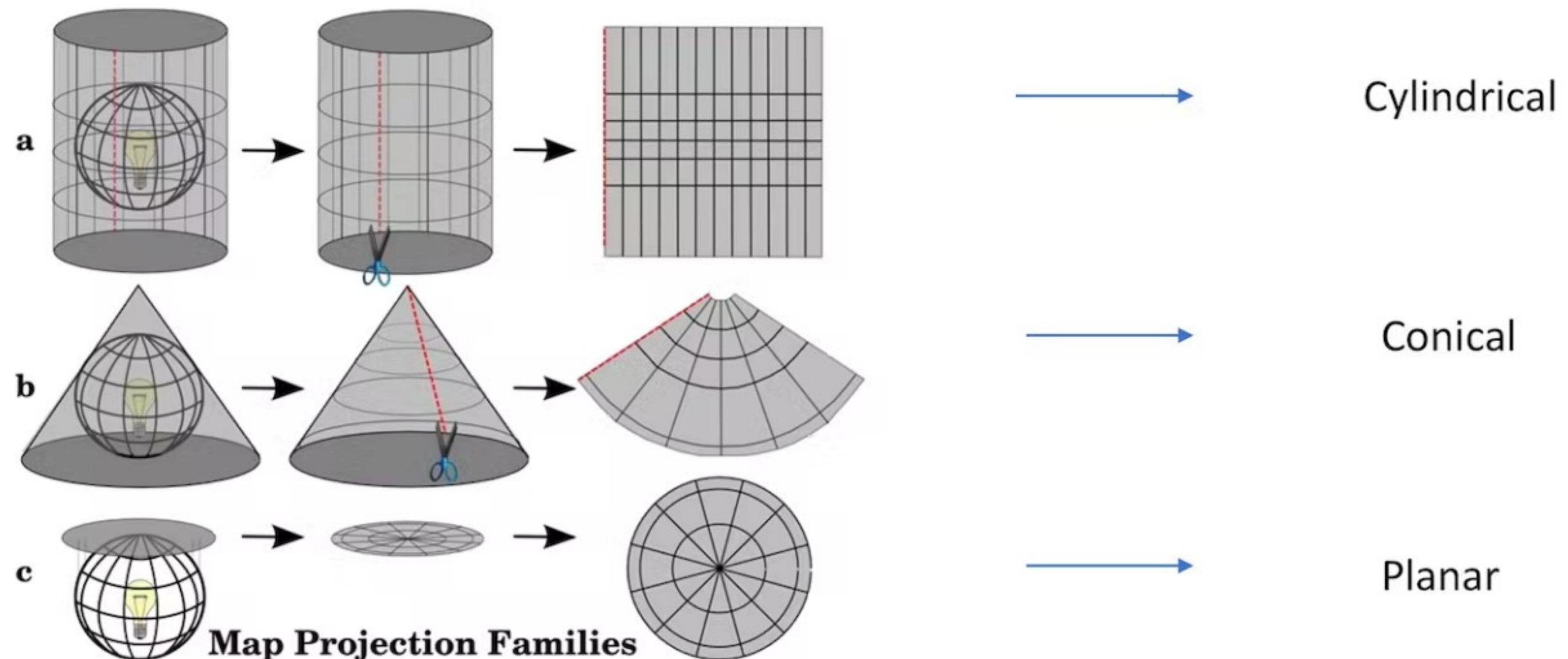


Distortion

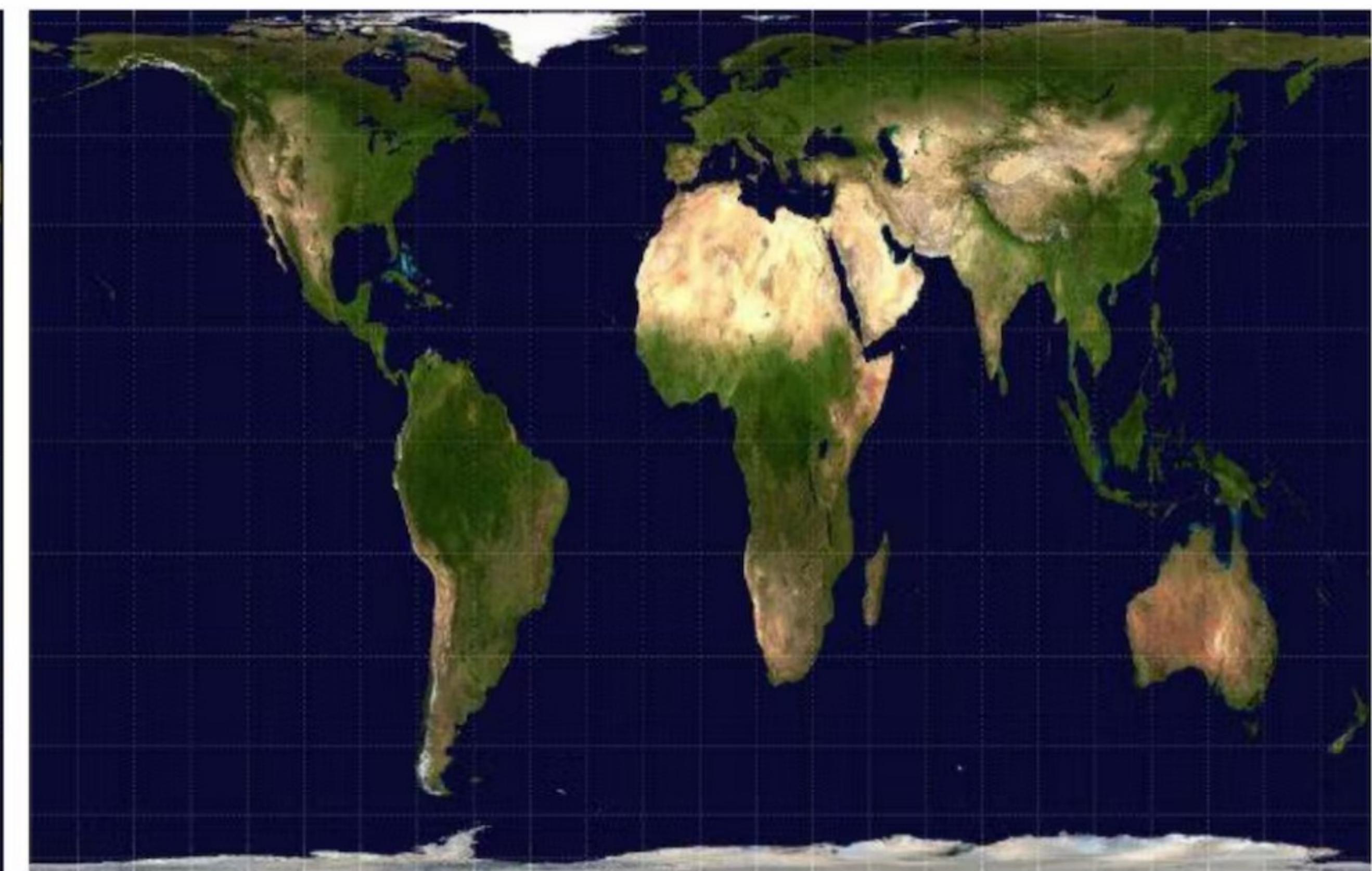
The misrepresentation of...

- > Area
- > Shape
- > Distance
- > Direction of points

Projection Families



Web Mercator vs Gall-Peter Projection

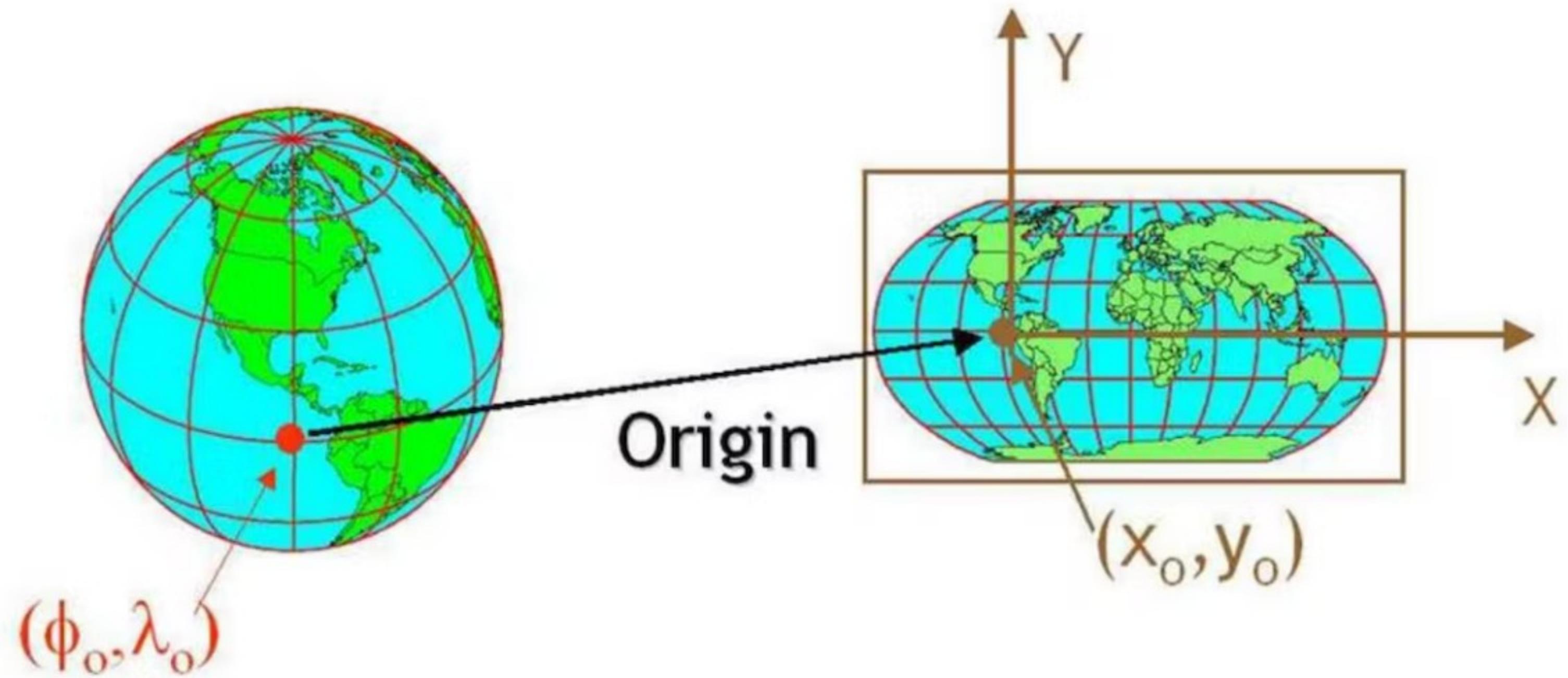


Break



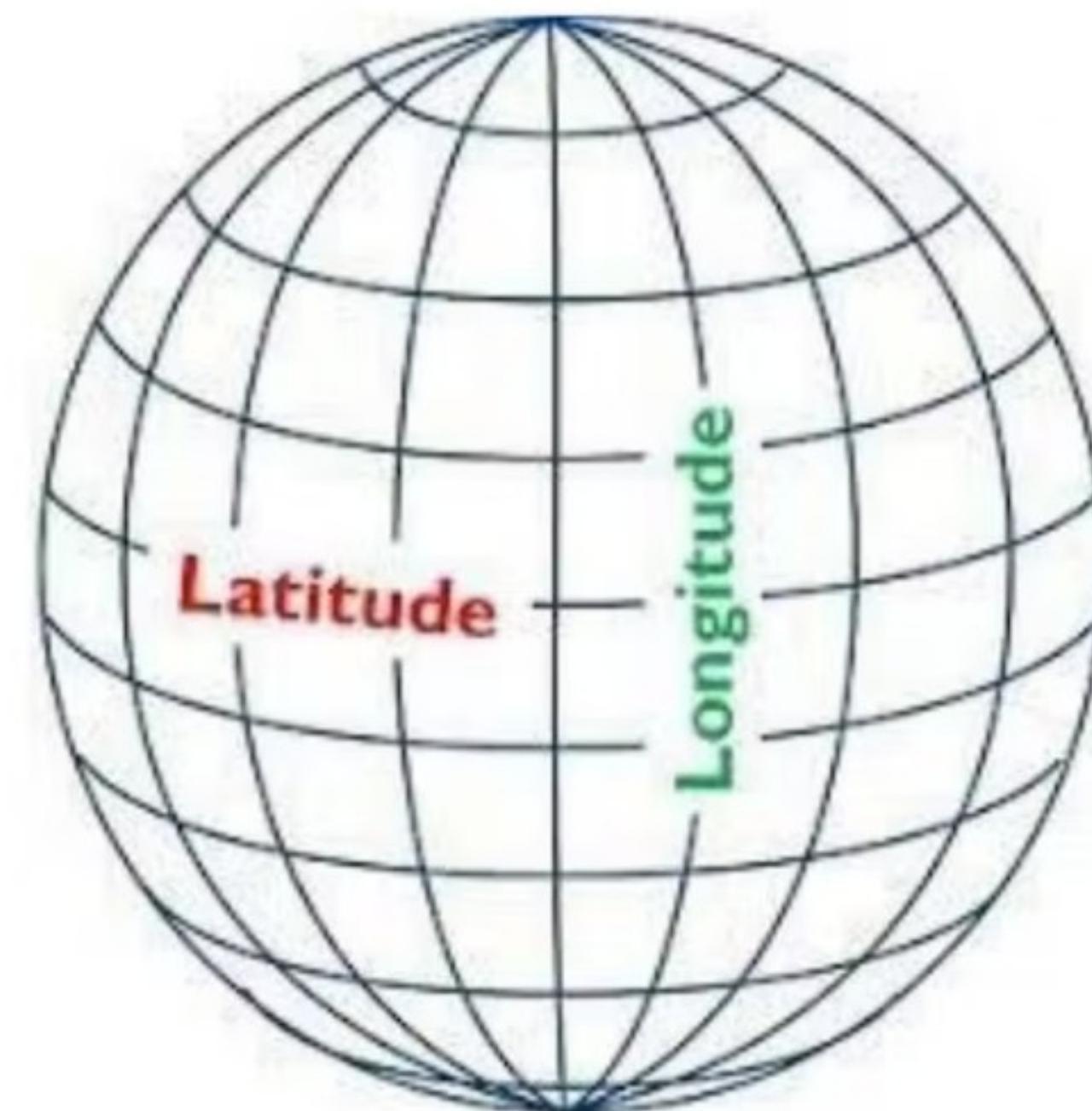


So, how do we actually move from the 3D to the 2D?



Coordinate Reference Systems (CRS)

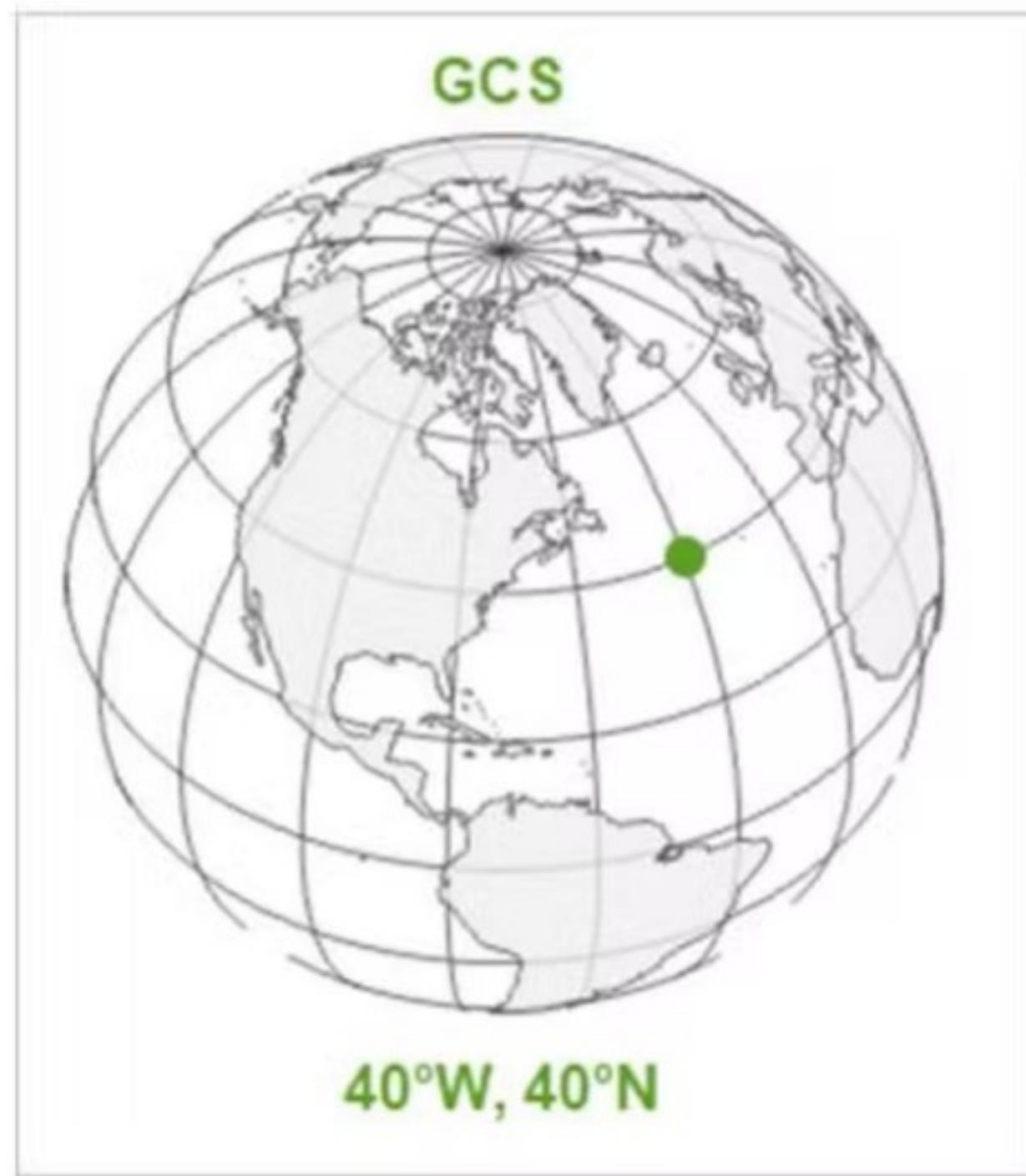
- The move from the 3D to the 2D is done with the help of CRS
- Every place on earth is specified by three numbers (i.e. coordinates)
 - Latitude, longitude and Altitude



CRS continued...

There are two Main CRS:

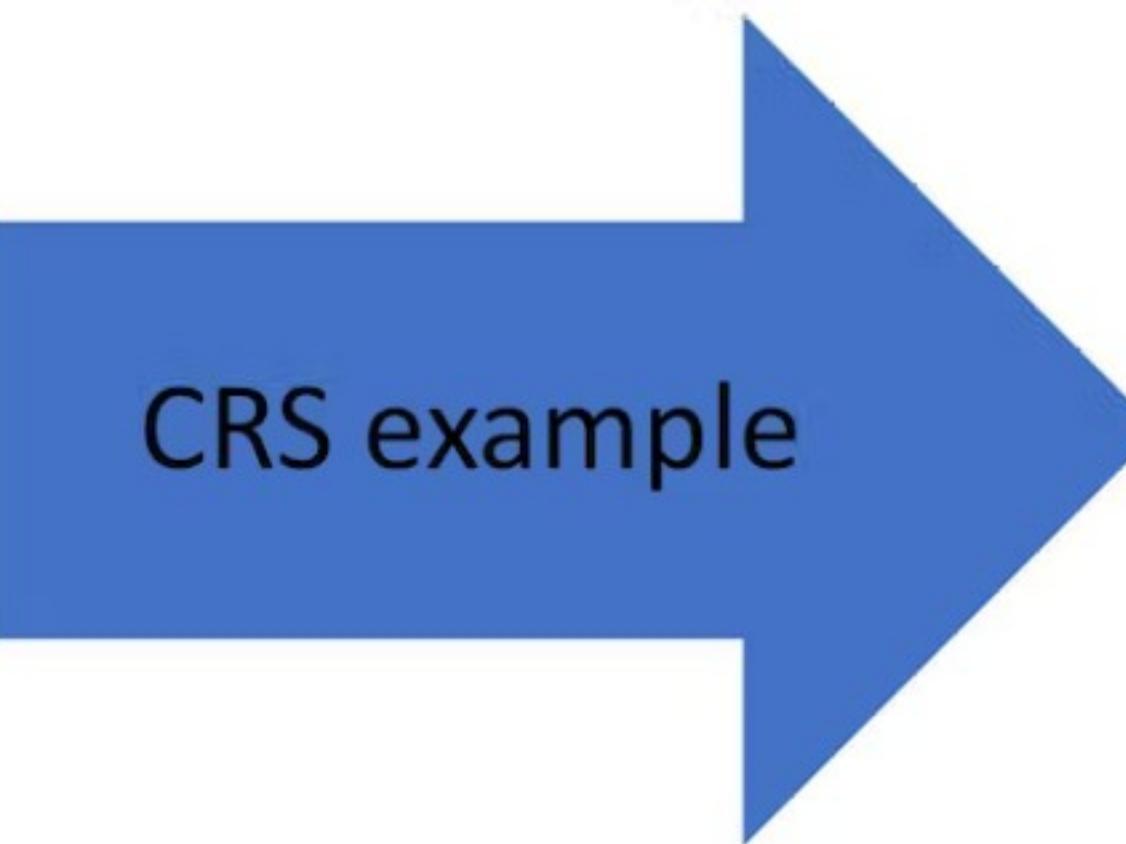
Geographic Coordinate System vs Projected Coordinate Systems



The 'where'



The 'how'



- Remember that a PCS, is just a GCS that has been projected !

Coordinate System Details

Projected Coordinate System	Fuller (world)	Tell me how to draw the earth on a flat surface!
Projection	Fuller	
WKID	54050	
Authority	Esri	
Linear Unit	Meters (1.0)	
False Easting	0.0	
False Northing	0.0	
Option	0.0	
Geographic Coordinate System	WGS 1984	Tell me where on the earth the data should draw!
WKID	4326	
Authority	EPSG	
Angular Unit	Degree (0.0174532925199433)	
Prime Meridian	Greenwich (0.0)	
Datum	D WGS 1984	
Spheroid	WGS 1984	
Semimajor Axis	6378137.0	
Semiminor Axis	6356752.314245179	
Inverse Flattening	298.257223563	

Spatial Analysis

- Buffering
- Overlay Analysis
- Interpolation
- Kernel Density Estimation
- Spatial Autocorrelation
- Hot-spot / Hot-Routes

What are the main challenges of mapping crime data?

- Geomasking and geoprivacy
- The accuracy of police recorded statistics
 - The grey figure of crime
 - Conceptual issues surrounding its definitions of crime types
 - The impacts of seasonality; how has Covid-19 affected police recorded crime statistics

Can you think of anymore?

What are the main challenges of mapping crime data?

no data

Deal with sensitive data

Under reporting of some crimes.

It worries me that something technical would go wrong

If the location data is missing and then we are unable to represent the crime fully.

incomplete data

the political situation can impact the way of creating crime map, and some areas might be not figure out the right number of crime data

Material for the live code demonstration

(08/03/2023)

GitHub:

https://github.com/UKDataServiceOpen/Crime_Data_in_R

(under the March_2023 folder)



Any Questions...

References

- <https://www.esri.com/en-us/what-is-gis/overview#liSwitcher>
- <https://blog.ukdataservice.ac.uk/gis-spatial-data/>
- Dermanis (2005) : https://www.researchgate.net/profile/Athanasiou-Dermanis/publication/233387161_Coordinates_and_Reference_Systems_in_Greek/links/0912f50a149d9568b700000/Coordinates-and-Reference-Systems-in-Greek.pdf
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- <https://www.crimrxiv.com/pub/slkb1v54/release/1>
- https://tubecreature.com/#/livesontheline/current/same/U/*/FFTFTF/11.469326848406268/-0.1622/51.5142/
- <https://www.crimrxiv.com/pub/slkb1v54/release/1>



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Thank You.

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