Handling Vector Data

Lab_03: Network Analysis

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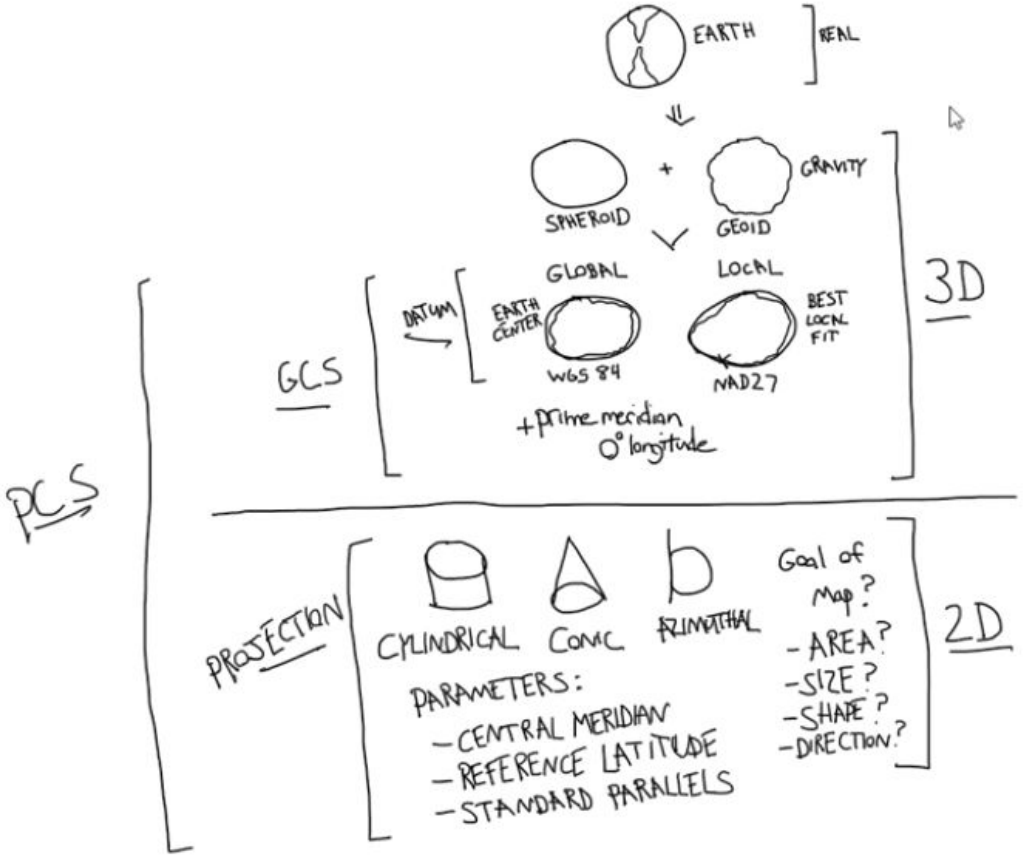
Introduction

Challenge 🎯

To go from 3D object (Earth) to a 2D representation (a map)



https://www.youtube.com/watch?v=B06Gmy-Qgac

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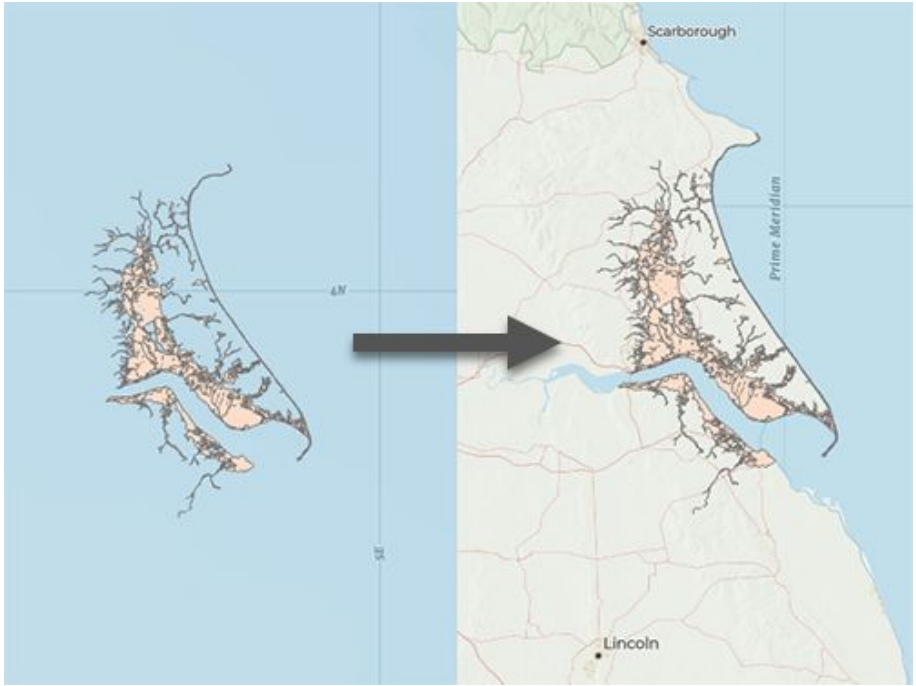
Coordinate systems

-Q: Why do we need a coordinate system?🤔

-A: Without a common coordinate reference, GIS data layers won't line up properly! 💡



https://learn.arcgis.com/en/projects/fix-data-when-it-appears-in-the-wrong-place/

https://docs.qgis.org/3.40/en/docs/gentle_gis_introduction/coordinate_reference_systems.html

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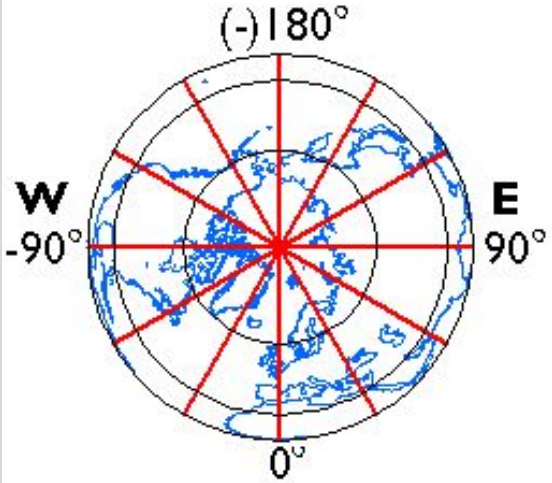
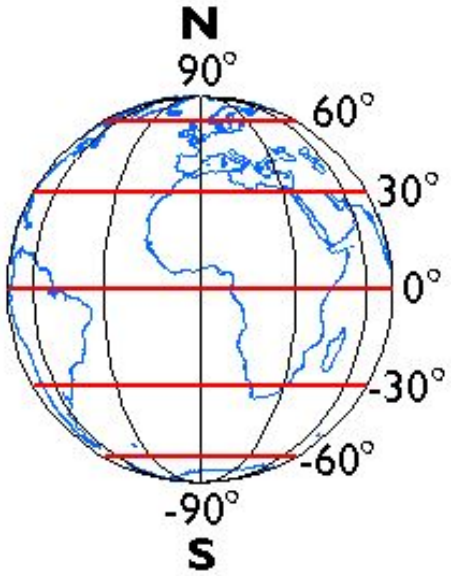
Defining key terms

Geographic Coordinate System (GCS)

- Identifies locations on the **curved surface** of the Earth
- Locations are defined by two values:

Latitude and Longitude





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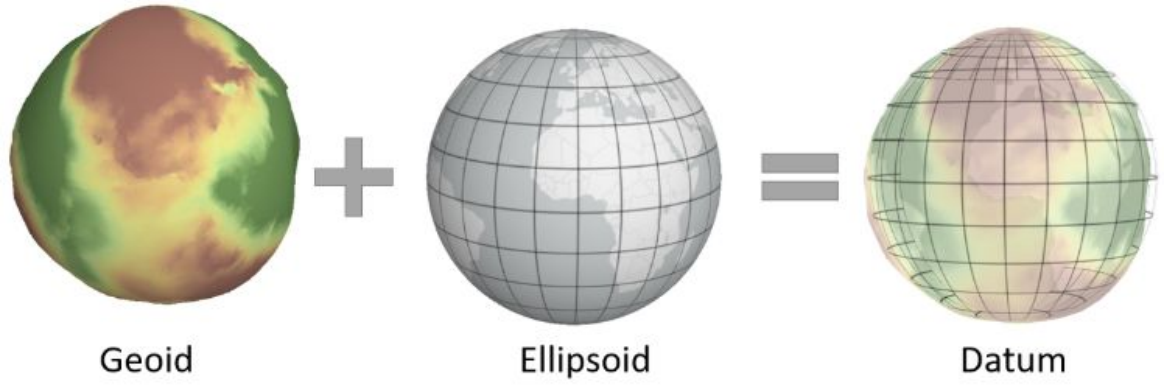
https://www.e-education.psu.edu/natureofgeoinfo/c2_p11.html

Defining key terms

A GCS is defined by three components

1. Geoid 2. Ellipsoid 3. Datum



https://mgimond.github.io/Spatial/chp09_0.html

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Defining key terms

Datum

An incorrect datum can place you hundreds of meters from your actual position!

WGS84, World Geodetic System of 1984 for global use

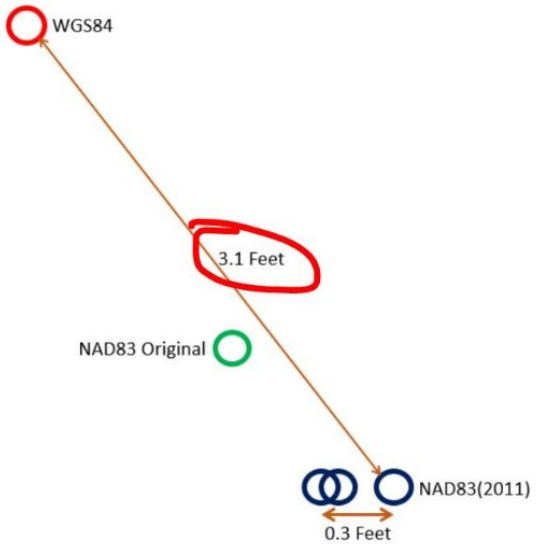
NAD83, North American Datum 1983 for North America

ETRS89, European Terrestrial Reference System 1989 for Europe

The global standard, used by GPS and for most international applications!

LFUCG GPS STA 0047

NAD83 vs WGS84



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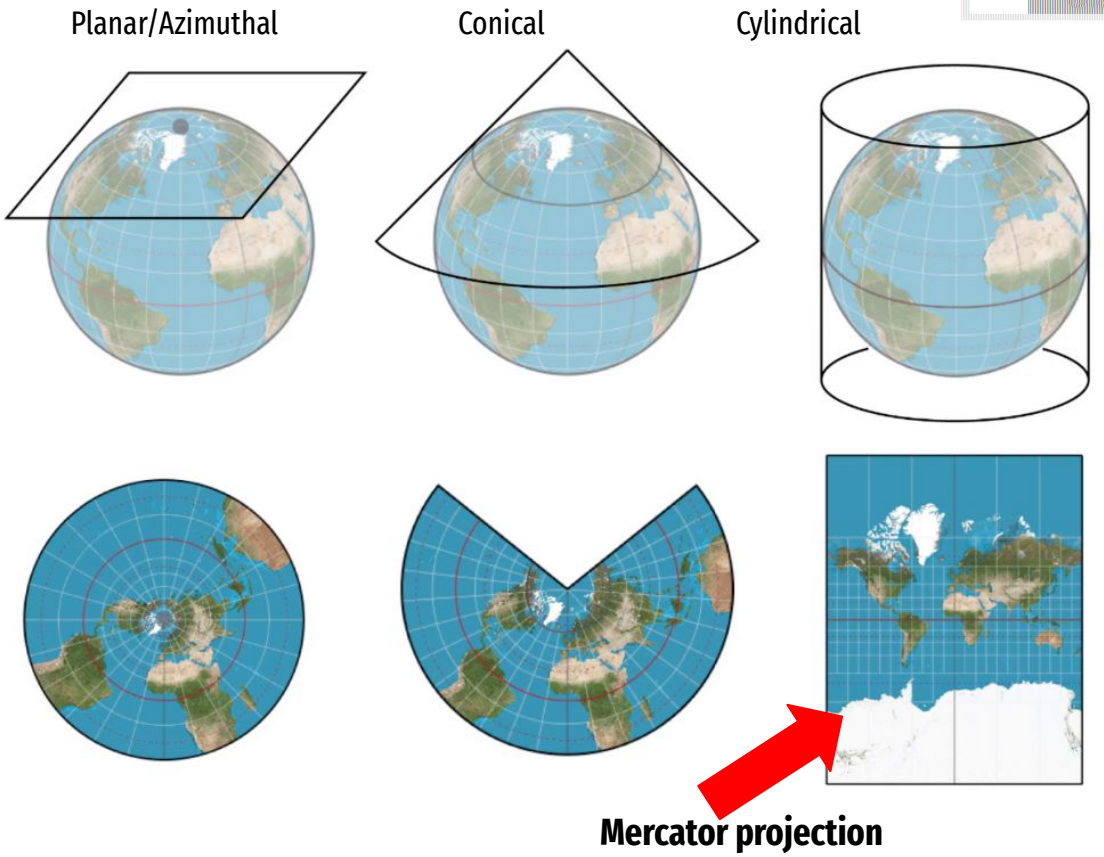
https://www.maptools.com/tutorials/map_datum
https://www.linkedin.com/pulse/wgs84-nad83-does-matter-david-carter

Defining key terms

Projected Coordinate System (PCS)

- Identifies locations & measuring features on a **flat surface**
- Transforming data from GCS to PCS requires mathematical projection. There are three broad categories:

Planar/Azimuthal **Conical** **Cylindrical**



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https://mapscaping.com/understanding_map_projections/

The orange peel problem in Cartography

https://www.youtube.com/watch?v=LN_tCKdl9cE

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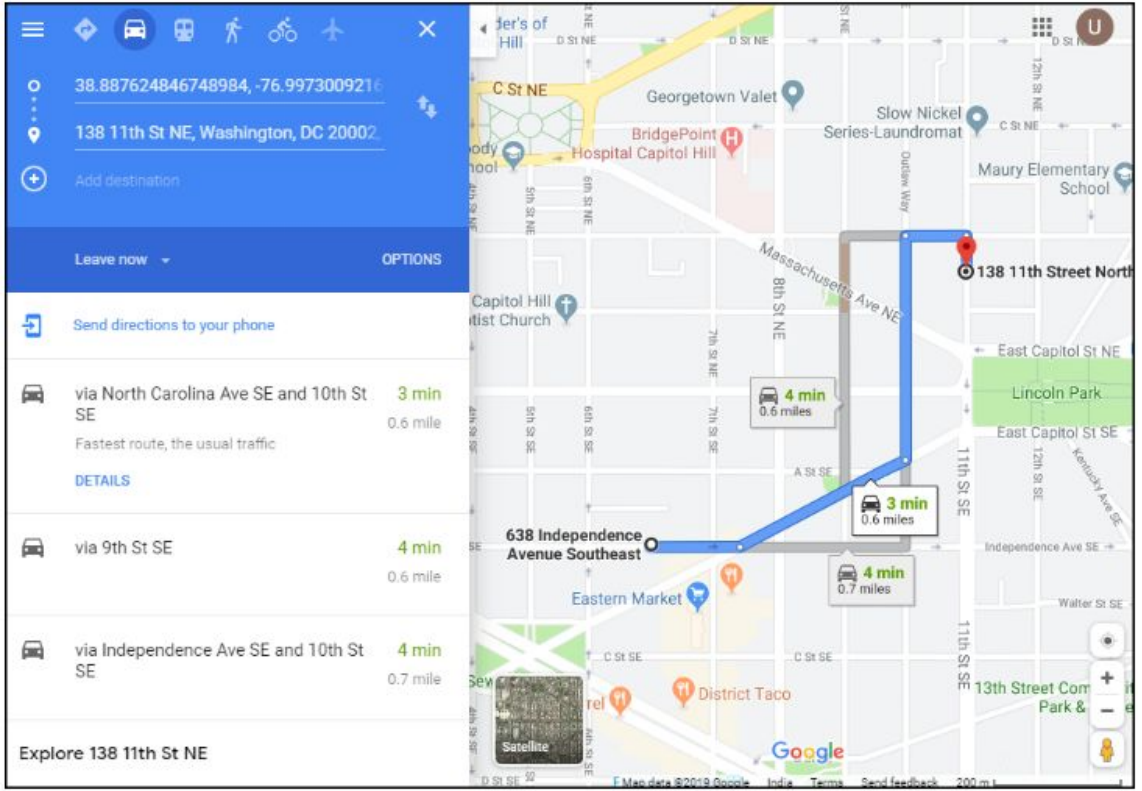
Network analysis

-Q: How does Google Maps find the fastest route?

-A: It uses network analysis. A set of GIS tools that model and analyze movement along connected lines!



https://www.qgistutorials.com/en/docs/3/basic_network_analysis.html

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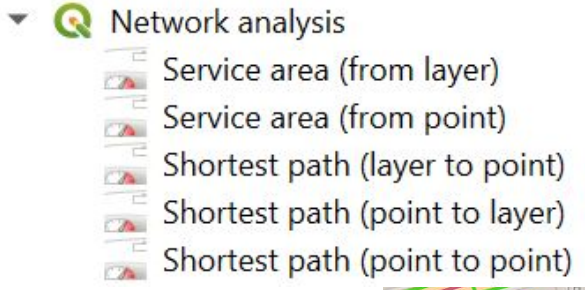
Network analysis & QGIS

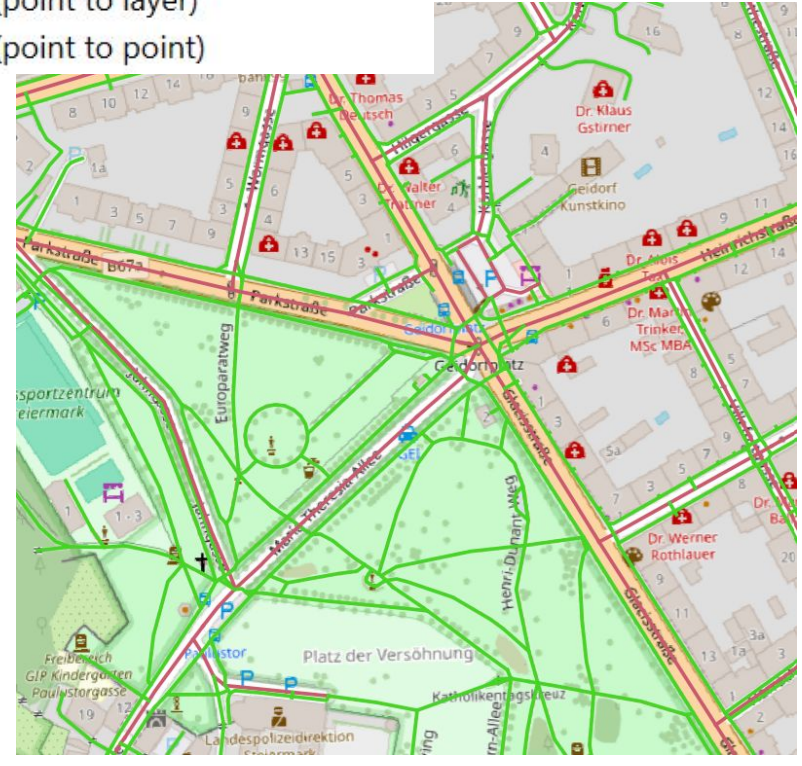


<u>A network is made of:</u>

- Nodes, connection points (intersections)
- Edges, paths between nodes (roads)

<u>QGIS can compute:</u>

- Shortest path
- Service area



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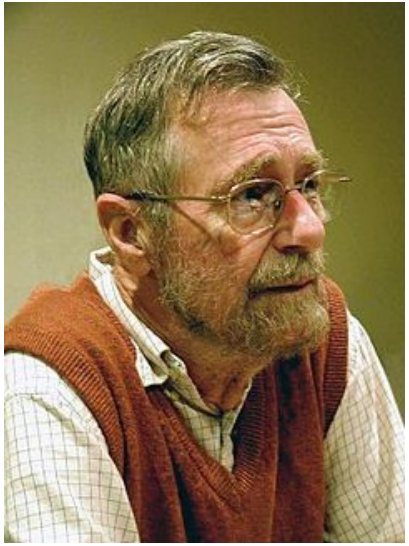
Shortest path

~ Questions related to the shortest path analysis ~

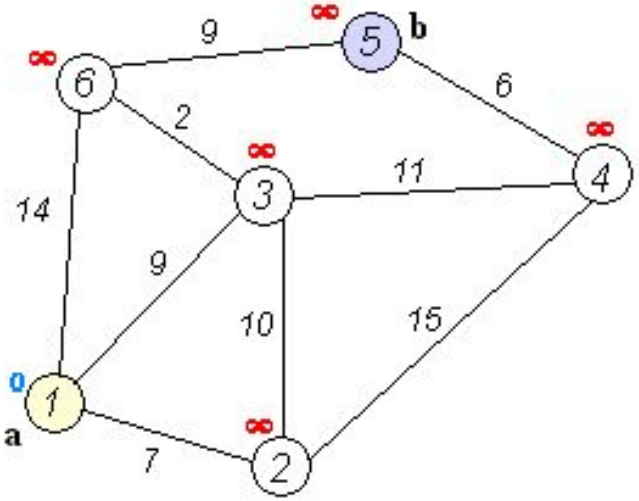
What is the fastest route from home to work?

How can city planners design road networks to minimize congestion and improve mobility?

How can utility companies find the shortest route for laying cables or pipes between two points?



Dijkstra's Algorithm



https://en.wikipedia.org/wiki/Dijkstra%27s_algorithm

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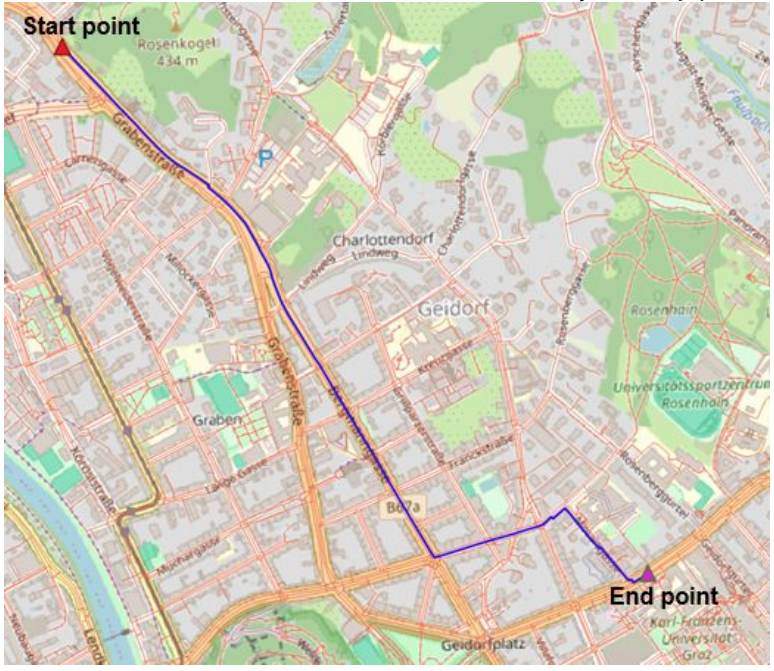
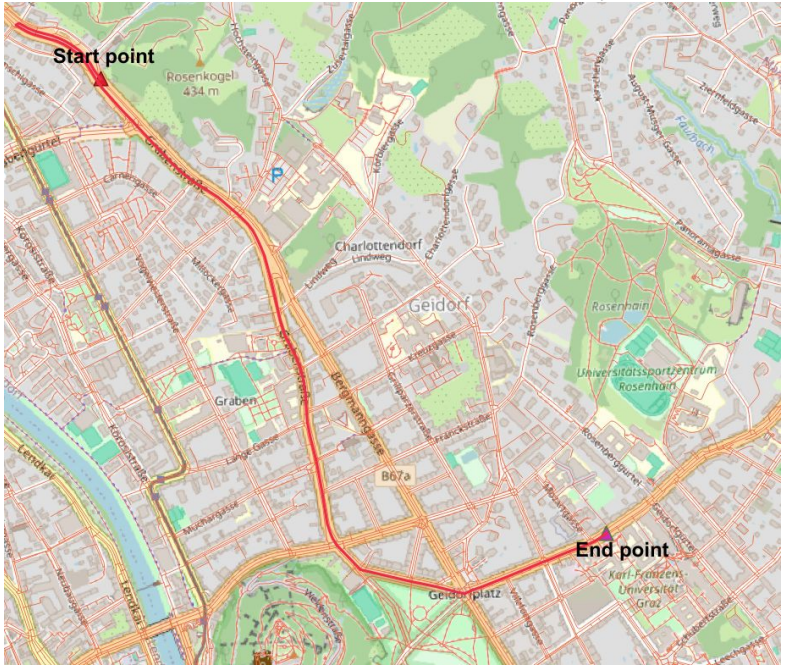
Shortest path example

What is the shortest path from start point to end point by foot ?



What is the fastest path from start point to end point by car ?



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Takeaway

Coordinate Systems	Network Analysis
“WHERE I AM”	“HOW I GET THERE”
Tells you exactly where things are on a map	Shows you the best way to get from one place to another

Why do both topics rely on spatial accuracy?

Accurate routing depends on correct spatial referencing!

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