The many ways of GIS for digital humanities

Summer School on Digital Humanities

Course material available at
https://github.com/AugustoCiuffoletti/DHSS_2025

Augusto Ciuffoletti

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What is digital cartography (aka GIS)

- Digital cartography shares fundamental principles with classical cartography:
  - It records the geographical position of objects or reference points
  - It represents the morphological features of the landscape
  - It maps travel routes and pathways
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  - It can yield imaginary landscapes or reconstruct past and future territorial scenarios

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Why do we use digital cartography?

- Digital and conventional cartography share similar purposes
- Both serve as essential tools for:
  - Measuring geometric dimensions of objects and areas
  - Defining and recording state and property boundaries
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Cartography and public history

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- The way we represent the world reflects our perspectives and values
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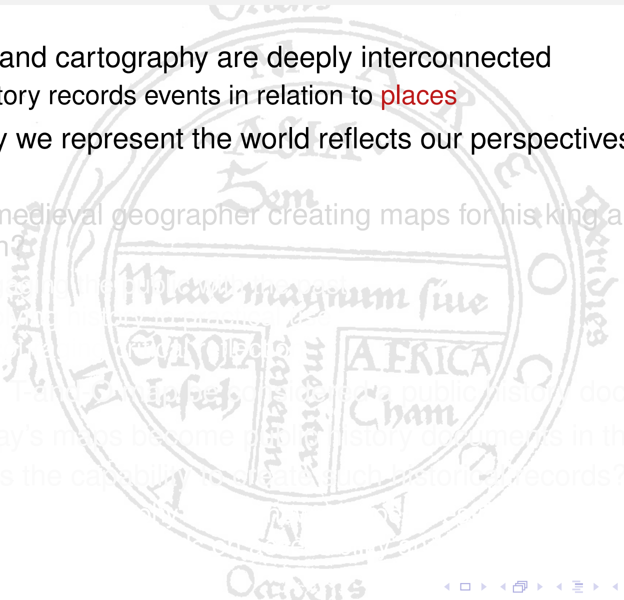

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- Digital cartography relies on:
  - Powerful graphics processors
  - High-definition displays
- In the Pentium era, these were largely inaccessible to PCs
- Digital cartography became widely affordable around 2005
- Today, nearly everyone carries a pocket-sized GIS engine
- Despite advancements, multiple representation standards still exist (standardization is ongoing)
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- Web mapping technology emerged a few years after the creation of the WWW in 1989
- The evolution of the Web paralleled the advancement of Web mapping
- In the early 90s, maps were primarily static, offering limited interaction or layering
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Web Mapping in Web 2.0

- More powerful personal computing devices enable real-time interaction with Web mapping servers
  - ...allowing maps to be generated as mashups from multiple databases
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Access: open vs closed digital cartography

- A fundamental choice in online content:
  - Data can be publicly accessible or restricted to private use
- The same distinction applies to digital cartography

Examples:

- Open-source cartography: OpenStreetMap
- Freely accessible but proprietary cartography: Google Maps
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- **Data Models**:
- **Additional Core Concepts**:
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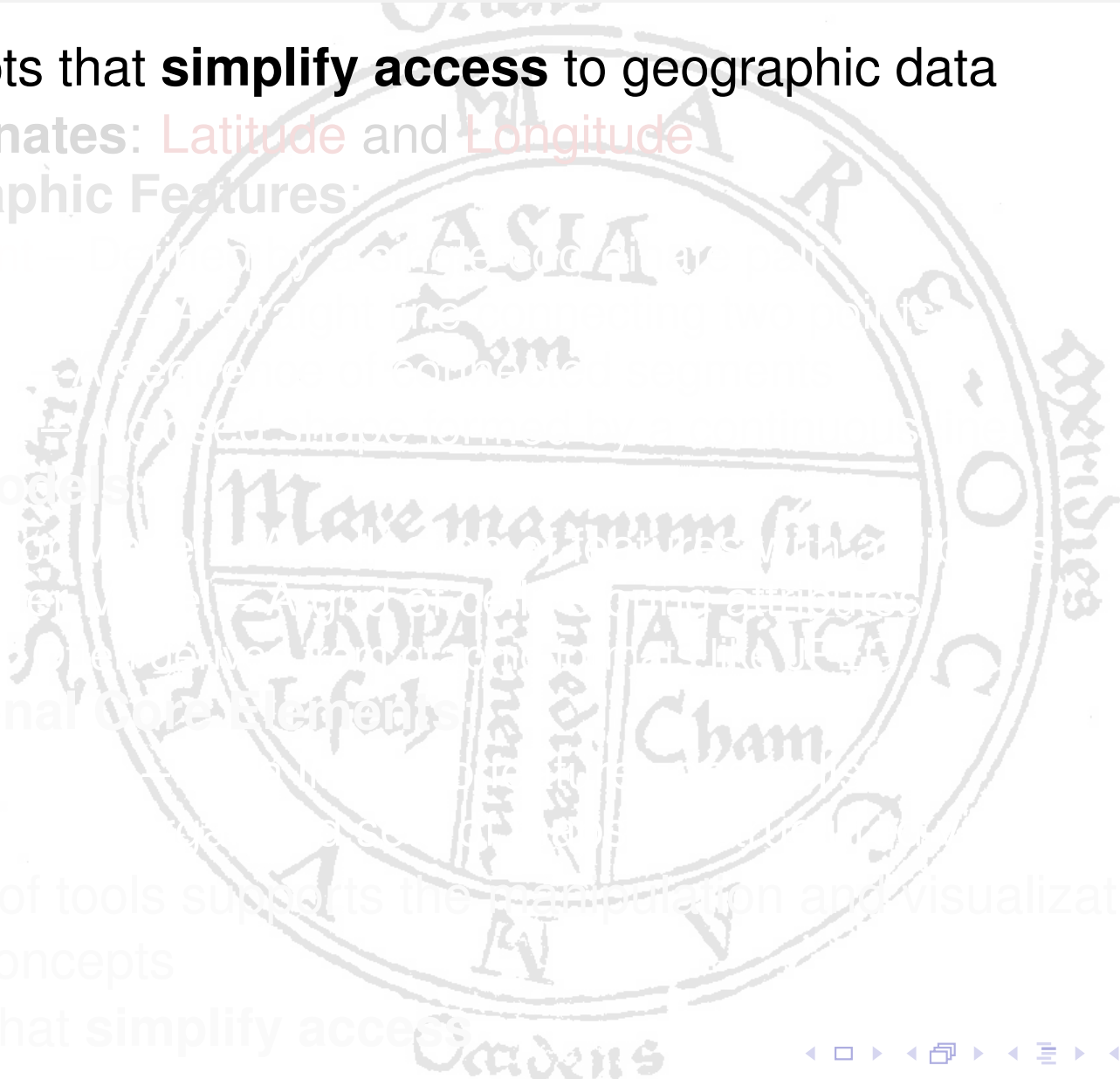

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- A widely adopted Geographic Coordinate System (GCS) today is `WGS84` (World Geodetic System 1984)
- The label `EPSG:4326` refers to its "non-projected" version
  - For example, `EPSG:3857` represents its Pseudo-Mercator projection on a spherical surface
- `WGS84` `EPSG:4326` is used by the Global Positioning System (GPS) and for data storage formats such as GeoJSON
- `WGS84` `EPSG:3395` is used by World Wide Web and computer visualization tools
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PostGIS: a relational GIS database

- A sample query that creates a new feature:

```
INSERT INTO places (name, coord)
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- Legend:
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  - The INSERT command adds a new row to the table
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  - Coordinates are provided as input to ST_GeographyFromText function from PostGIS
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  - 4326 refers to the WGS 84 standard (EPSG:4326)
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    VALUES ('Pisa', ST_GeographyFromText('SRID=4326;POINT(10.41 43.72)'));
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- Legend:
  - places is a table created beforehand
  - It contains two columns: one for the name of a place and one for its coordinates
  - The INSERT command adds a new row to the table
  - The new point is named Pisa
  - Coordinates are provided using the ST_GeographyFromText function from PostGIS
  - The input string includes an SRID to define the coordinate system
  - 4326 refers to WGS 84 (code for EPSG:4326)
  - Coordinates follow the format longitude first, then latitude — note the order is reversed relative to common WGS 84 descriptions

PostGIS: a relational GIS database

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GeoJSON: maps as JavaScript objects

- GeoJSON is a GIS extension of the JSON object description language
- A `map_layer` variable hosting a collection of features is initialized as

```
map_layer = { "type": "FeatureCollection",
              "features": [] }
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- A new point feature is defined with

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new_feature = { "type": "Feature",
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- And the JavaScript statement to insert the new feature in the empty collection is:

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map_layer["features"].append(new_feature)
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GeoJSON and noSQL databases

- The previous example refers to variables in the scope of a Javascript program
- Using a noSQL database service, the service provides an API based on JavaScript objects
- The following snippet connects to a MongoDB server, selects a collection and inserts a new feature

```
client = MongoClient("mongodb://localhost:27017") # Connect to DB
db = client["gis_database"] # Select a database
collection = db["map_layer"] # Select a collection
# insert the feature
collection.insert_one(
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Going deeper

The rest of this tutorial is divided into six introductory hands-on sessions:

- Fundamentals of QGIS
- Working with OpenStreetMap
- Creating Maps with uMap
- Using GaiaGPS for Field Data
- Georeferencing in QGIS
- Introduction to the Leaflet Library