

The many ways of GIS for digital humanities

Summer School on Digital Humanities

Course material available at

https://github.com/AugustoCiuffoletti/dhss_2021

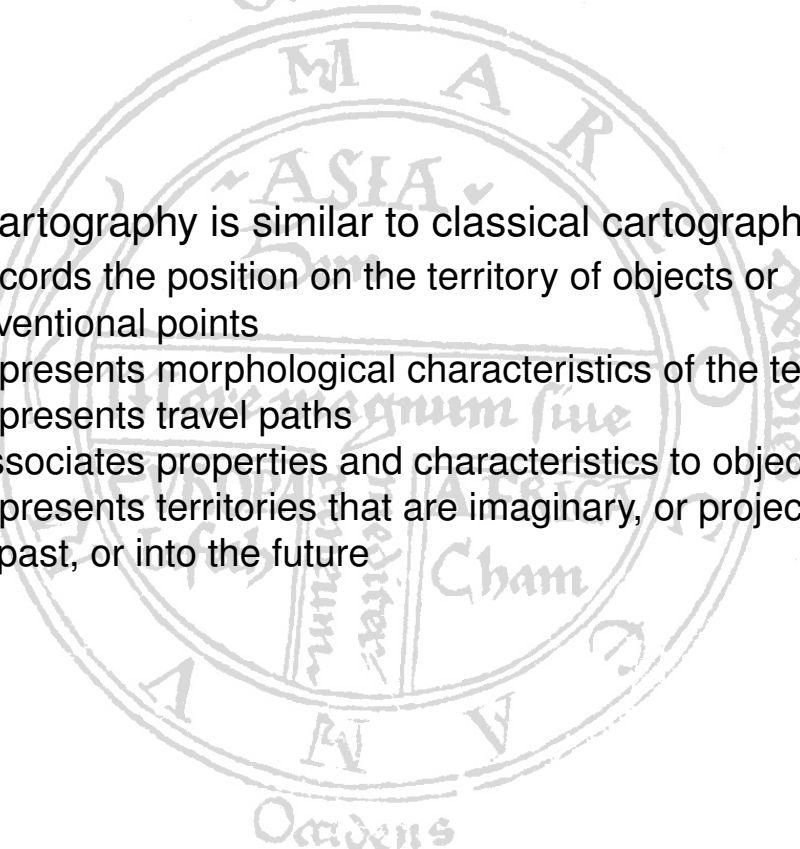
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What is digital cartography (aka GIS)

- Digital cartography is similar to classical cartography
 - It records the position on the territory of objects or conventional points
 - It represents morphological characteristics of the territory
 - It represents travel paths
 - It associates properties and characteristics to objects
 - It represents territories that are imaginary, or projected into the past, or into the future



Why do we use digital cartography?

- Also the purpose of digital and conventional cartography are similar
- Both of them are useful to:
 - Compute geometric dimensions relative to objects and areas
 - Determine and register borders of states and properties
 - Determine routes to reach destinations
 - Document trips and other kinds of travel
 - Geographically place human or natural events to find relationships
 - Describe (teach) places that are beyond our reach
- Such utilizations may be in the present, or projected in the future, or in the past

The advantages of digital cartography

- Digital and classical cartography differ for the **support** on which a map is registered
 - a digital map is recorded on a digital support, accessible via a suitable device
- Such difference carries important advantages
 - dematerialization of the map, which is **easily shared**
 - possibility of **automatic acquisition** of positions and movements
 - possibility to **merge data** coming from different maps
 - possibility to link **multi-media** information to the map
 - **simplicity** of creation, re-utilization

Cartography and public history

- History is strongly related with cartography
 - History is the record of events and **places**
- The way we see the world tells a lot about us
- A medieval geographer that draws a map for his king is a **public** historian?
 - ...public engagement with the past...
 - ...putting history to work...
 - ...fostering critical reflection...
- The T-and-O map is a public history document?
- A map of our world today is (going to be) a public history document tomorrow?
- Who has the ability to produce such documents?
- Digital cartography gives new answers to this question
 - that depend on its diffusion

Diffusion of digital cartography

- Digital cartography depends on
 - powerful graphic processors,
 - high definition displays
- Both inaccessible to personal computers in Pentium era
 - ...curtailing advantages previously listed
- Digital cartography becomes affordable after 2005 (approx)
- Today everybody has a pocket-size GIS engine
- There are still many ways to represent the same item (standardization is ongoing)
- Today, cartography is accessible to anybody with appropriate technical skills
- The present challenges:
 - **simplify access**
 - **unify** representation (for merging)
- The future:
 - create **autonomous things** that record our history
 - enhance **communication** of history

Web Mapping

- Web is a powerful way to share resources
- Web mapping technology emerges a few years after the creation of the WWW, in 1989
- Web evolution marked a parallel evolution of Web mapping
- Initially the map is presented as such, with limited possibilities of interaction/layering (early '90s)
- A further step consists of allowing users to manipulate maps and to build new ones (late '90s)
 - ... the heavy task is off-loaded to the server
- The evolving Web technology fosters the creation of Web mapping services (2000-2005)
 - ... allowing their integration with other services through standard interfaces
 - ... the definition of standard representations and interfaces becomes crucial

Web Mapping in Web 2.0

- Faster personal computing devices allow technologies for real time interaction with the Web mapping server
 - ... maps produced as a mashup of data from several databases
- The Web 2.0 (2005) allows crowd-sourcing geospatial data
- Faster personal computers allow client side manipulation of map features
 - ... supported by cloud storage and servers for authentication and sharing.

Access: open vs closed digital cartography

- An alternative which is always present on the Internet:
 - the content may be publicly accessible, or kept private
- Same option is present in cartography

Examples:

- Open source: Open Street Map
 - Maps are in the public domain
 - Anyone can add features to the maps
 - Maps can be reused
- Free cartography: Google Maps
 - Access to the map is through a private service
 - Anyone can add his own map
- Private maps: mapbox
 - Maps are delivered for a fee
 - Fee increases with number of views

Simplicity: few basic concepts

- Coordinates (**latitude** and **longitude**)
- **Features**:
 - A **point** (associated with a pair of coordinates)
 - A **segment** (made of two points)
 - A **line** (composed of several segments)
 - An **area** (a surface delimited by a closed line)
- **Vector** graphic (a set of **features**)
- **Raster** graphic (pointwise representation of an area)
 - **Cell** (a point in a raster)
 - Each cell has coordinates (georeferenced)
- **Attributes** (associated with features and cells)
- **Layers** (ordered sets of maps)
- A set of tools simplifies the management of such concepts

Geographic Coordinate Systems

- A Geographic Coordinate System is a way to represent a point on Earth System
- A standard GCS has a fundamental role in sharing meaningful informations about positions, tracks, distances
- The standard evolves in response to changing needs and improved technology
 - latitude originally computed from the maximum length of a day

World Geodetic System of 1984

- Today, A widely adopted GCS is WGS84 (for World Geodetic System 1984)
- A further label attached with it is EPSG4326 to refer to its "non projected" version
 - e.g., EPSG:3856 stands for its Pseudo-Mercator projection on a square surface
- WGS84 EPSG4326 used by the Global Positioning System (GPS) and for data storage (GeoJSON)
- WGS84 EPSG3856 used by Google Maps and computer visualizations tools
- Facts about WGS84 EPSG4326
 - coordinates are expressed in latitude (north), longitude (east) (in that order)
 - coordinates are expressed in degrees (decimal form)

Goals

- This tutorial aims at giving the **basic** skills to update and create GIS maps
- We treat GIS from various perspectives (local, server based, cloud)
- We learn the basics for:
 - creating new features
 - creating new rasters
 - tracking an itinerary with a GPS receiver
 - uploading our track on a GIS map
 - creating a new service

A glimpse on GIS databases

- Specialized databases register features and attributes
- An example in Postgis:

```
INSERT INTO places (name, coord)
VALUES ('Pisa', ST_GeographyFromText ('SRID=_4326;_POINT_(10.41_43.72)'));
```

- Legend:
 - **places** is a table that I created earlier
 - it has two columns that describe the **name** of a point and its **coordinates**
 - With the **INSERT** command I enter a new registration
 - The name of the new point is *Pisa*
 - The coordinates are entered with a specific Postgis function: **STGeographyFromText**
 - The text string contains an SRID parameter that identifies the **Coordinate system**
 - 4326 = WGS84 EPSG:4326
 - and the indication of a point: first the **longitude**, then the **latitude** (yes, reverse wrt WGS84)

GeoJSON is gaining momentum

- An extension of the JSON object description language
- Flexible, programmer-friendly
- Hosted by NoSQL databases
- An example in GeoJSON:

```
{ "type": "Feature",  
  "properties": {},  
  "geometry": {  
    "type": "Point",  
    "coordinates": [ 12.338194, 45.433048 ]  
  }  
}
```