Critical GIS

WHAT IS GIS?



WHAT WE WILL LEARN



Data Collection, Manipulation & Management



Cartography & Visualization



Spatial Analysis



Statistical & Modeling



GEOGRAPHICAL REPRESENTATION

COGNITIVE MAPPING AND MENTAL MODEL

CARTOGRAPHY IS A SOCIAL CONSTRUCT

THEMATIC MAPPING

Measuring the Earth

- Geodesy
- The Earth has an oblate spheroid shape, which is complex to model accurately.
- Simplifications
- We use an ellipsoid as a more practical and manageable representation of the Earth's surface.





Plotemy - Geographia

Latitude and Longitude

Latitude (Parallels)

- Measures north to south
- 90°in each hemisphere
- Increases as you go north in the northern hemisphere
- Increases as you go south in the southern hemisphere
- Zero is Equator

Longitude(Meridians)

- Measures east to west
- 180°in each hemisphere
- Increases as you go east in the eastern hemisphere
- Increases as you go west in the western hemisphere
- Zero is Prime Meridian



1 ° Degree = 60 Minutes = 3,600 Seconds

Time Zones







Islamic Medieval Cartography

Al-Idrisi

MAP PROJECTIONS

- Map projections allow us to view the 3D Earth on a 2D surface
- Earth is mathematically projected to a surface that can be made flat
- We now make measurements in distance or length units as opposed to degrees
- A Cartesian coordinate system
- We call these surfaces Map Projections



Geographic vs. Projected Coordinate Systems





MAP DISTORSIONS





https://www.thetruesize.com/













Ibn Battuta, 29 years (1325–1354) 117,000 km



Zheng He, 28 years (1405– 1433), 50,000 km







MAP 2-6 VOYAGES OF ZHENG HE, 1405-1483

What count as Data?

Non-Spatial Data in GIS



Attributes = non-spatial characteristics associated with spatial data Nominal = A unique identifier or unique types

Categorical

Ordinal = Ranked data



Interval = Difference between numbers is significant, but no fixed nonarbitrary zero point

Numeric



Ratio = Difference between numbers is significant, and there is a fixed non-arbitrary zero value

Nominal Data



Interval Data



Ratio Data





*Includes four provinces, federal capital, and Azad Kashmir. Data is not available for Gilgit-Baltistan as of July 2021

> 2021 Division Borders in use

Total: 36.07%*

Punjab: 36.86% Sindh: 51.89% Khyber Pakhtunkhwa: 16.55% Balochistan: 27.62% Azad Jammu & Kashmir: 17.37% Islamabad Capital Territory: 50.37%

Top Five

Karachi Division: 92.88% Lahore Division: 69.40% Islamabad Capital Territory: 50.37% Rawalpindi Division: 41.32% Faisalabad Division: 36.87%

Bottom Five

Bannu Division: 5.41% Malakand Division: 10.43% Hazara Division: 10.75% Loralai Division: 12.40% Zhob Division: 13.58%

Source: 2017 Pakistan Population & Housing Census

VECTOR DATA?





1. Manually Adding Points from QGis

Create a New Point Layer

1. Open QGIS and go to Layer > Create Layer > New Shapefile Layer.

2. In the dialog:

- 1. Set File Name and Save location.
- 2. Choose Geometry Type as Point.
- 3. Set CRS (Coordinate Reference System) (e.g., WGS 84 / EPSG:4326).
- 4. Add any necessary attributes (e.g., "Name", "ID").
- 5. Click OK.

Start Editing the Layer

- 1. In the Layers Panel, select your new point layer.
- 2. Click on the **Toggle Editing** button (pencil icon) in the **Toolbar**.
- 3. Click on the Add Point Feature tool (looks like a point).
- 4. Click anywhere on the map where you want to add a point.
- 5. Click Save Edits and Toggle Editing off.



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Export as CSV

Select Your Layer In the Layers Panel

- right-click your point layer.
- Click Export > Save Features As....

Configure Export Settings In the Save Vector Layer

- Format: Choose Comma Separated Value (CSV).
- File Name: Click Browse and choose a location to save your CSV.
- Layer Options:
 - Geometry: Choose Point coordinates.
 - Make sure Geometry is set to "AS_XY" (this ensures latitude/longitude are included).
 - CRS: Select WGS 84 (EPSG:4326) for standard lat/lon coordinates.
 - Encoding: Keep as UTF-8 (to avoid character issues).

Why = Easier to deal with CSV than shapefile + remote sensing imagery

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2. Data from Google Maps

- Open Google Maps
- Right Click
- Careful Google maps is lat long
- Paste in csv file
- Clean up



Load CSV into QGIS

- Open QGIS and go to Layer → Add Layer → Add Delimited Text Layer...
- 2. Click "..." next to File Name and select your CSV file.
- 3. In the File Format section, select:
 - **1. CSV (comma-separated)** (or adjust if using another delimiter).
- 4. In Geometry Definition:
 - 1. Select Point Coordinates.
 - 2. Set **X Field** to long (Longitude).
 - 3. Set **Y Field** to lat (Latitude).
- 5. Choose the Coordinate Reference System (CRS):
 - 1. If coordinates are in WGS 84, select EPSG:4326.
 - 2. If using another CRS, choose accordingly.
- 6. Click **Add** → **Close**.

Save as a Shapefile

- 1. Right-click the CSV layer in Layers Panel.
- 2. Click Export → Save Features As....
- 3. Choose ESRI Shapefile (or another format).
- 4. Select the appropriate **CRS** and location, then save.

ADD DELIMITED TEXT LAYER

Q Data Source Man	ager Delimited Text					-		×
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Raster	CSV (comma separated values)							
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Point Cloud	O Custom delimiters							
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GPS	\checkmark First record has field names		Trim fields					
	✓ Detect field types		Discard empty	fields				
SpatiaLite	Custom boolean literals							
PostgreSQL	True		False					
MS SQL Server								
	Point coordinates	X field	•	Z field			•	
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API -	Please select an input file							
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Geolocated Photos

Apple

1. Enable Location Services for Camera

- 1. Go to Settings → Privacy & Security → Location Services
- 2. Ensure Location Services is ON
- 3. Scroll down and select Camera
- 4. Choose While Using the App or Always

2. Verify Geotagging in Photos

- 1. Open Camera and take a picture
- 2. Open Photos app, select the image, and swipe up
- 3. If location appears, geotagging is active

3. Troubleshooting

- 1. If no location is saved, restart the phone and retake the photo
- 2. Ensure **Airplane Mode is OFF** (GPS needs connectivity)

Android

- **1. Enable Location Services**
 - 1. Go to **Settings** → **Location**
 - 2. Toggle Use Location ON
- 2. Enable Location for Camera
 - 1. Open the Camera app
 - 2. Go to Settings (Gear Icon)
 - 3. Look for **Save Location / Location Tags / Geotagging** (varies by brand)
 - 4. Turn it **ON**

3. Verify Geotagging in Photos

- 1. Take a picture
- 2. Open Google Photos or Gallery
- 3. Swipe up on the photo and check if a map/location appear

3. Geolocated Photos

Vector Creation - Import Geotagged Photos		×
Parameters Log	•	Import geotagged photos
Input folder Scan recursively Photos [optional] [Create temporary layer] Open output file after running algorithm Invalid photos table [optional] [Skip output] Open output file after running algorithm		Creates a point layer corresponding to the geotagged locations from JPEG or HEIF/HEIC images from a source folder. Optionally the folder can be recursively scanned. The point layer will contain a single PointZ feature per input file from which the geotags could be read. Any altitude information from the geotags will be used to set the point's Z value. Optionally, a table of unreadable or non- geotagged photos can also be created.
0%		Cancel
Advanced Run as Batch Process		Run Close Help

How to preserve geolocation data?

- WhatsApp/Telegram etc removes EXIF metadata.
- You can still share geolocated images using these methods:
- Method 1: Send as a "Document" (Keeps GPS Data)
- 1.Open WhatsApp and go to the chat.
- 2. Tap the paperclip (Android) or "+" icon (iPhone).
- 3.Select **Document** → **Browse Other Docs**.
- 4. Navigate to your **photo folder** and select the image.
- 5.Send the photo **without compression**—the metadata, including location, remains intact.

4. Satellite Imagery

- How to Get an API Key?
- 1.Sign up at https://browser.dataspa ce.copernicus.eu/
- 2.Navigate to Dashboard → Access & Authentication.
- 3.Create a new API Key under OAuth Clients.
- 4.Use the key in your API requests or applications.



Adding Fields

- Create layer and add fields
- Make sure to define the correct type

Data Type	Description
Short Integer	Integer values between -32,768 and 32,767
Long Integer	Integer values between - 2,147,483,648 and 2,147,483,647
Float	Decimal values with 1-6 decimal places
Double	Decimal values with more the 6 decimal places
Text	Text strings
Date	Data info (mm/dd/yyyy)

File name			example.shp						
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Add Geometric Fields

• Use Add Geometry Attributes Tool

Spatial Data Type	Geometry?	v Open c
points	X y coordinates	
lines	Length bearing	Advanced
polygons	Area/perimeter/centroid	

Q Vector Geometry - Add Geometry Attributes

Run as Batch Process...

Parameters Log	•	Add geometry attributes
Parameters Log Input layer Selected features only Calculate using Layer CRS Added geom info [Create temporary layer] Open output file after running algorithm		Add geometry attributes This algorithm computes geometric properties of the features in a vector layer. It generates a new vector layer with the same content as the input one, but with additional attributes in its attributes table, containing geometric measurements. Depending on the geometry type of the vector layer, the attributes added to the table will be different.
0%		Cancel

Run

Close

Help

Select by Location

 Select based on spatial relationships to other geographic features

Q Vector Selection - Select by Location	×
Parameters Log	Select by location
Select features from	This algorithm creates a selection in a vector layer. The criteria for selecting features is based
Where the features (geometric predicate) intersect touch contain overlap disjoint are within equal cross By comparing to the features from Selected features only Modify current selection by creating new selection	and the features in an additional layer.
0%	Cancel
Advanced 💌 Run as Batch Process	Run Close Help

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OF SYMBOLS AND REPRESENTATIONS





Outline of Hereford Mappa Mundi c. 1285, showing modern countries