



QGIS: a local application

Summer School on Digital Humanities

Web site: <https://bit.ly/dt4h-gis>

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QGIS: a local application

- The user installs a GIS application on the PC



User

- In this scenario, the Web is a tool for exchanging data
 - but it is not created by the user
- QuantumGIS (QGIS) is an open source GIS application
- Runs on Windows, Linux, and macOS

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- In this scenario, the Web is a tool for exchanging data
 - but it is not directly involved
- Quantum GIS (QGIS) is an open-source GIS application
 - Developed by the Open Source Geospatial Foundation
 - First released in 2003
 - Platform-independent
- Runs on Windows, Linux, and macOS

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- In this scenario, the Web is a tool for exchanging data
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- Quantum GIS (QGIS) is an open-source GIS application
 - Developed and maintained by volunteers
 - First released in 2002
 - Here we use version 3.34 (Preraphael)
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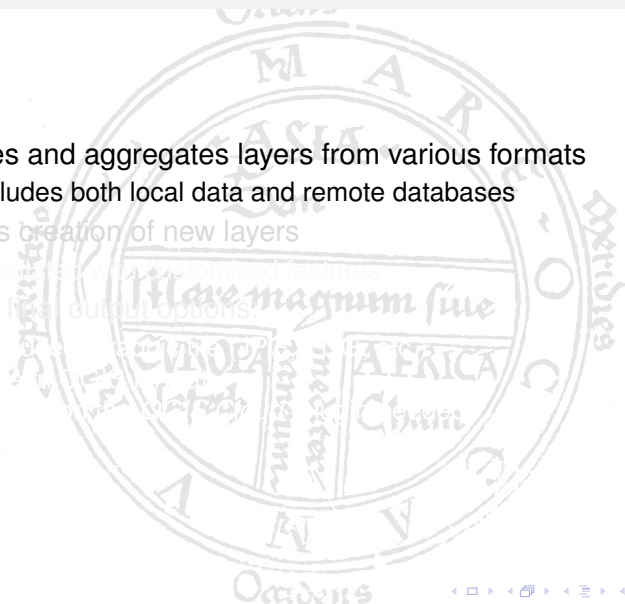
QGIS Operation

- Acquires and aggregates layers from various formats
 - Includes both local data and remote databases
- Enables creation of new layers
- Among the main functions



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- Acquires and aggregates layers from various formats
 - Includes both local data and remote databases
- Enables creation of new layers
 - Populated with customized features
- Among final output options:
 - Print to a pdf
 - Save as image

QGIS Operation

- Acquires and aggregates layers from various formats
 - Includes both local data and remote databases
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- Among final output options:
 - Produce a **graphic file** (PDF, PNG, etc.)
 - **Save** in QGIS format
 - **Publish** on the web (plugin needed)

QGIS Operation

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Hands-on QGIS - Load a raster

Create a New Project

- Open QGIS and select Project -> New

Add a Raster Background Layer

- Layer -> Data Source Manager -> XYZ Tiles

- Double-click on OpenStreetMap

- Use the controls to zoom in on a specific region

Understanding the Raster Background Layer

- The map is now available as a raster layer

- Various providers offer raster layers



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- Open QGIS and select Project -> New

Add a Raster Background Layer

- Layer -> Data Source Manager -> XYZ Tiles

- You can also use the Ctrl-L instead of using the menu

- Double-click on OpenStreetMap

- Use the controls to zoom in on a specific region

Understanding the Background Layer

- The map is now available as a background layer

- Various providers offer raster providers

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Add a Raster Background Layer

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Understanding the Raster layer

- The map is now displayed as a raster layer
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Understanding the Raster Layer

- The map is now displayed as a raster layer
 - Composed of multiple images joined to an image
 - Cannot be reprojected
- Various providers offer raster services

Hands-on QGIS - Load a raster

Create a New Project

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Add a Raster Background Layer

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 - You can also use the Ctrl-L instead of using the menu
- Double-click on OpenStreetMap
- Use the control pad to zoom in on a specific region

Understanding the Raster Layer

- The map is now displayed as a **raster** layer
 - Composed of multiple **tiles**, similar to an image
 - Cannot be modified within QGIS
- Various providers offer raster layers

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• OpenStreetMap is a free, open-source provider

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Hands-on QGIS - Add a Vector Layer

Define a Vector Layer

- Layer -> Create Layer -> New Shapefile Layer
 - Or use the New Shapefile icon in the toolbar (third icon in the second row)
- Choose:



- Add new fields for the new layer
- The new layer appears in the Layers Panel
- Two layers shown, Demo and OpenStreetMap
- We can edit the Demo vector layer

Hands-on QGIS - Add a Vector Layer

Define a Vector Layer

- **Layer -> Create Layer -> New Shapefile Layer**
 - Or use the *New Shapefile* icon in the toolbar (third icon in the second row)
- Choose:



- Add new layers from the *Layers Panel*
- The new layer appears in the *Layers Panel*
- Two layers shown, *Demo* and *OpenStreetMap*
- We can edit the *Demo* vector layer

Hands-on QGIS - Add a Vector Layer

Define a Vector Layer

- **Layer -> Create Layer -> New Shapefile Layer**
 - Or use the *New Shapefile* icon in the toolbar (third icon in the second row)

- Choose:

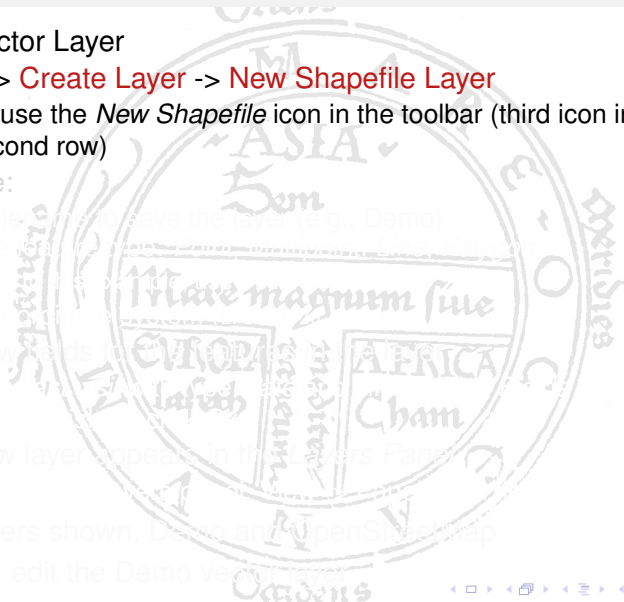
- A file name to save the layer (e.g., Demo)
- The coordinate reference system

- Add new fields for the layer

- The new layer appears in the Layers Panel

- Two layers shown, Demo and OpenStreetMap

- We can edit the Demo vector layer



Hands-on QGIS - Add a Vector Layer

Define a Vector Layer

- **Layer** -> **Create Layer** -> **New Shapefile Layer**
 - Or use the *New Shapefile* icon in the toolbar (third icon in the second row)
- Choose:
 - A filename to save the layer (e.g., Demo)
 - The feature type: *Point, Multipoint, Line, Polygon*
 - A coordinate system (EPSG:4326)
- Add new layers from the toolbar
- The new layer appears in the Layers Panel
- Two layers shown, Demo and OpenStreetMap
- We can edit the Demo vector layer

Hands-on QGIS - Add a Vector Layer

Define a Vector Layer

- **Layer** -> **Create Layer** -> **New Shapefile Layer**
 - Or use the *New Shapefile* icon in the toolbar (third icon in the second row)
- Choose:
 - A filename to save the layer (e.g., Demo)
 - The feature type: *Point, Multipoint, Line, Polygon*
 - A coordinate system (EPSG:4326 WGS84)
- Add new layers to the map
- The new layer appears in the Layers Panel
- Two layers shown, Demo and OpenStreetMap
- We can edit the Demo vector layer

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Define a Vector Layer

- **Layer -> Create Layer -> New Shapefile Layer**
 - Or use the *New Shapefile* icon in the toolbar (third icon in the second row)
- Choose:
 - A filename to save the layer (e.g., Demo)
 - The feature type: *Point, Multipoint, Line, Polygon*
 - In this example, use *Point*
 - A coordinate system (EPSG:4326 WGS84)
- Add new fields for the attributes in the layer
- The new layer appears in the Layers Panel
- Two layers shown, Demo and OpenStreetMap
- We can edit the Demo vector layer

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Define a Vector Layer

- **Layer** -> **Create Layer** -> **New Shapefile Layer**
 - Or use the *New Shapefile* icon in the toolbar (third icon in the second row)
- Choose:
 - A filename to save the layer (e.g., Demo)
 - The feature type: *Point*, *Multipoint*, *Line*, *Polygon*
 - In this example, use *Point*
 - A coordinate system (EPSG:4326 WGS84)
- Add new fields for the features in the layer
- The new layer appears in the Layers Panel
- Two layers shown, Demo and OpenStreetMap
- We can edit the Demo vector layer

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 - In this example, use *Point*
 - A coordinate system (EPSG:4326 WGS84)
- Add new fields for the features in the layer
 - e.g. *Latitude*, *Longitude*
 - When finished, click *Add* to finish
- The new layer appears in the *Layers Panel*
- Two layers shown, *Demo* and *OpenStreetMap*
- We can edit the *Demo* vector layer

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 - In this example, use *Point*
 - A coordinate system (EPSG:4326 WGS84)
- Add new fields for the features in the layer
 - e.g. *Last visit* with type *Date* and click *Add to Fields List*
 - When finished, click *OK*
- The new layer appears in the *Layers Panel*
- Two layers shown, *Demo* and *OpenStreetMap*
- We can edit the *Demo* vector layer

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 - To view the *Layers Panel*, click the *Layers* icon in the toolbar and click *Layers*
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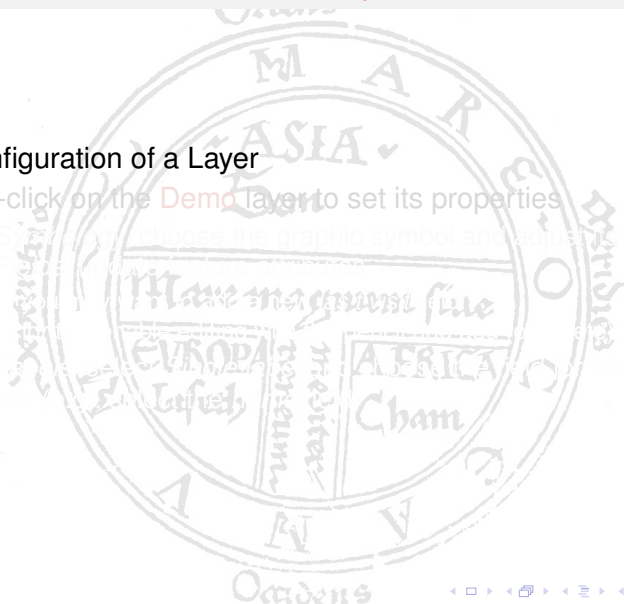
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Hands-on QGIS - Refine the layer definition

Further Configuration of a Layer

- Double-click on the **Demo** layer to set its properties
- In Symbol, choose the graphic symbol and adjust its properties
- In Properties, choose the layer's color and adjust its properties



Hands-on QGIS - Refine the layer definition

Further Configuration of a Layer

- Double-click on the **Demo** layer to set its properties
 - In *Symbology*, choose the graphic symbol and adjust its properties
 - In *Fields*, update feature attributes
 - In *Labels*, select which fields and choose the field for labeling the points (e.g. *continent* and *editor*)

Hands-on QGIS - Refine the layer definition

Further Configuration of a Layer

- Double-click on the **Demo** layer to set its properties
 - In *Symbology*, choose the graphic symbol and adjust its properties
 - In *Fields*, update feature attributes
 - In *Fields*, click on the **+** button to add a new field
 - In *Fields*, click on the **+** button to add a new field
 - In *Labels*, click on the **+** button to add a new label for labeling the points (e.g. **name**)

Hands-on QGIS - Refine the layer definition

Further Configuration of a Layer

- Double-click on the **Demo** layer to set its properties
 - In *Symbology*, choose the graphic symbol and adjust its properties
 - In *Fields*, update feature attributes
 - you may want to add a new field
 - for this enable editing with the pencil and add (or delete) a field
 - In *Labels*, select single label and choose the field for labeling the points (e.g. parent name field)

Hands-on QGIS - Refine the layer definition

Further Configuration of a Layer

- Double-click on the **Demo** layer to set its properties
 - In *Symbolology*, choose the graphic symbol and adjust its properties
 - In *Fields*, update feature attributes
 - you may want to add a new *last visit* field
 - for this enable editing with the pencil and add (or delete) a field
 - In *Labels*, select *Single label* and choose the field for labeling the points (e.g. select the name field)

Hands-on QGIS - Refine the layer definition

Further Configuration of a Layer

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 - In *Fields*, update feature attributes
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 - for this enable editing with the pencil and add (or delete) a field
 - In *Labels*, select *Single label* and choose the field for labeling the points (e.g. select the name field)

Hands-on QGIS - Refine the layer definition

Further Configuration of a Layer

- Double-click on the **Demo** layer to set its properties
 - In *Symbology*, choose the graphic symbol and adjust its properties
 - In *Fields*, update feature attributes
 - you may want to add a new *last visit* field
 - for this enable editing with the pencil and add (or delete) a field
 - In *Labels*, select *Single label* and choose the field for labeling the points (e.g., select the *name* field)

Hands-on QGIS - Working with points

Populate a Vector Layer (with Points)

- Select the **Demo** layer and **Layer -> Toggle editing**

- Or the pencil in the toolbar

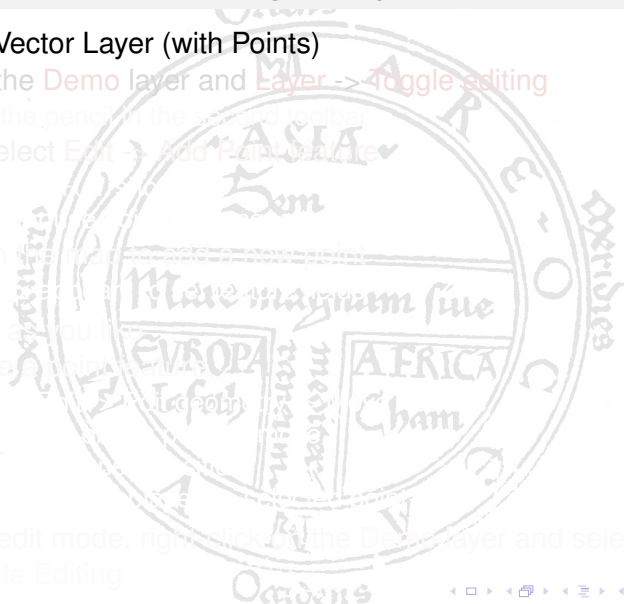
- Then select **Edit -> Add Point feature**

- Click on the map

- Repeat as you like

- To move a point

- To exit edit mode, right-click on the **Demo** layer and select **Layer -> Toggle Editing**



Hands-on QGIS - Working with points

Populate a Vector Layer (with Points)

- Select the **Demo** layer and **Layer** -> **Toggle editing**

- Or the pencil in the second toolbar

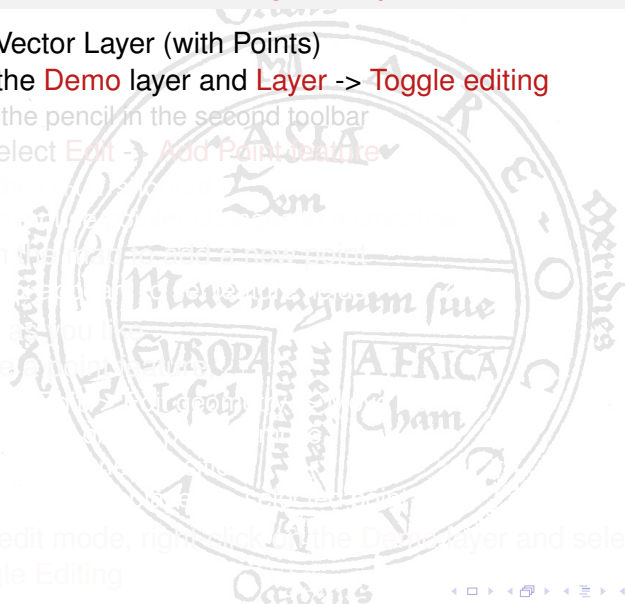
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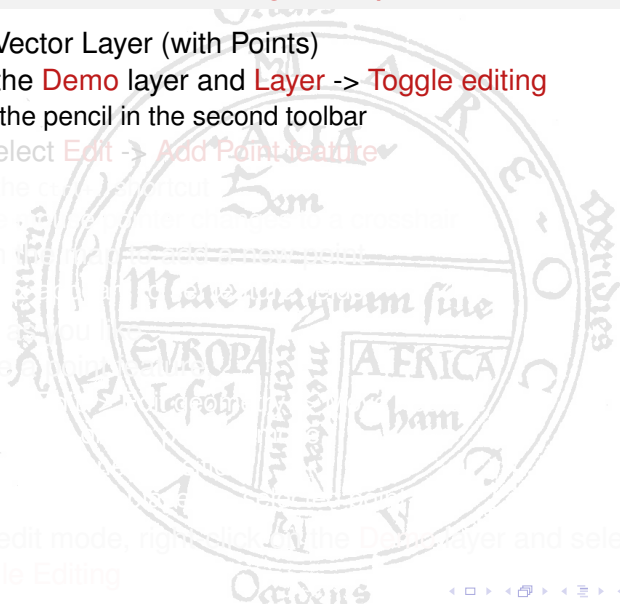
- or the crosshair shortcut
- The cursor pointer changes to a crosshair

- Click on the map to add a point

- Repeat as you like

- To move a point, click on it

- To exit edit mode, right-click on the **Demo** layer and select **Layer** -> **Toggle Editing**



Hands-on QGIS - Working with points

Populate a Vector Layer (with Points)

- Select the **Demo** layer and **Layer** -> **Toggle editing**
 - Or the pencil in the second toolbar
- Then select **Edit** -> **Add Point feature**

- or the **ctrl+I** shortcut
- The mouse pointer changes to a crosshair

- Click on the map to add a new point

- Repeat as you like

- To move a point:

- To exit edit mode, right-click on the **Demo** layer and select **Layer** -> **Toggle Editing**

Hands-on QGIS - Working with points

Populate a Vector Layer (with Points)

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 - Or the pencil in the second toolbar
- Then select **Edit** -> **Add Point feature**
 - or the **ctrl+.** shortcut
 - The mouse pointer changes to a crosshair
- Click on the map to add a new point
- Repeat as you like
- To move a point, click on it
- To exit edit mode, right-click on the **Demo** layer and select **Layer** -> **Toggle Editing**

Hands-on QGIS - Working with points

Populate a Vector Layer (with Points)

- Select the **Demo** layer and **Layer** -> **Toggle editing**
 - Or the pencil in the second toolbar
- Then select **Edit** -> **Add Point feature**
 - or the **ctrl+.** shortcut
 - The mouse pointer changes to a crosshair

- Click on the map to add a new point

- A box will appear with the fields

- Repeat as you like

- To move a point:

- To exit edit mode, right-click on the **Demo** layer and select **Layer** -> **Toggle Editing**

Hands-on QGIS - Working with points

Populate a Vector Layer (with Points)

- Select the **Demo** layer and **Layer** -> **Toggle editing**
 - Or the pencil in the second toolbar
- Then select **Edit** -> **Add Point feature**
 - or the `ctrl+.` shortcut
 - The mouse pointer changes to a crosshair
- Click on the map to add a new point
 - A box appears to set feature fields
- Repeat as you like
- To move a point feature
- To exit edit mode, right-click on the **Demo** layer and select **Layer** -> **Toggle Editing**

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 - right click on the point to move
 - drag to the new position
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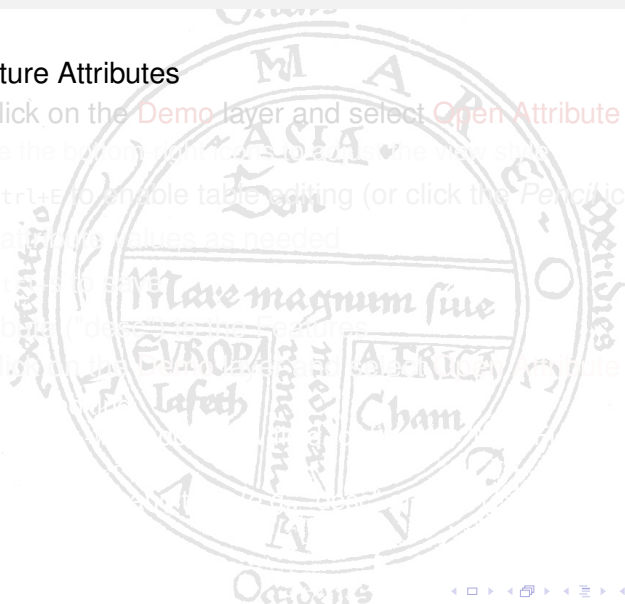
Hands-on QGIS - Edit fields

Update Feature Attributes

- Right-click on the **Demo** layer and select **Open Attribute Table**
 - Use the bottom-right icon to change the view style
- Press **ctrl+E** to enable table editing (or click the **Pencil** icon)
- Modify attribute values as needed

Add an Attribute ("demo" layer)

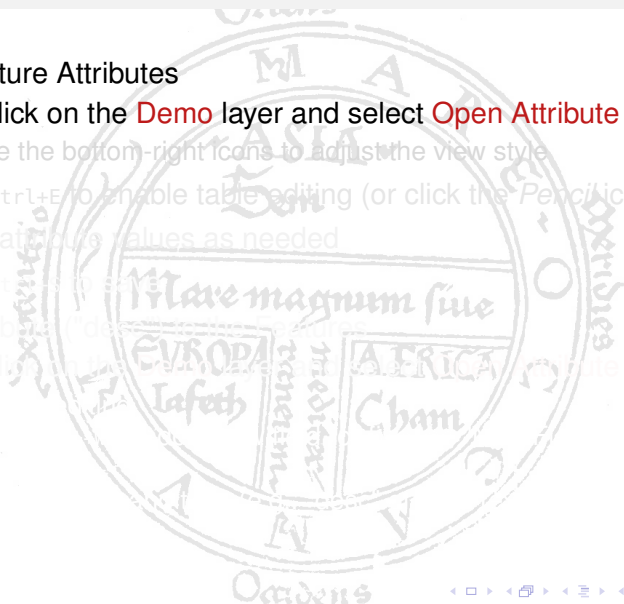
- Right-click on the **Demo** layer and select **Open Attribute Table**



Hands-on QGIS - Edit fields

Update Feature Attributes

- Right-click on the **Demo** layer and select **Open Attribute Table**
 - Use the bottom-right icons to adjust the view style
 - Press ctrl+E to enable table editing (or click the Pencil icon)
 - Modify attribute values as needed
 - Press ctrl+S to save
- Right-click on the **Demo** layer and select **Add New Attribute**



Hands-on QGIS - Edit fields

Update Feature Attributes

- Right-click on the **Demo** layer and select **Open Attribute Table**
 - Use the bottom-right icons to adjust the view style
- Press **ctrl+E** to enable table editing (or click the *Pencil* icon)
- Modify attribute values as needed
- Press **ctrl+S** to save

Add an Attribute ("demo" Features)

- Right-click on the **Demo** layer and select **Open Attribute Table**

Hands-on QGIS - Edit fields

Update Feature Attributes

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 - Use the bottom-right icons to adjust the view style
- Press **ctrl+E** to enable table editing (or click the *Pencil* icon)
- Modify attribute values as needed
- Press **ctrl+S** to save

Add an Attribute ("desc") to the Features

- Right-click on the **Demo** layer and select **Open Attribute Table**

Hands-on QGIS - Edit fields

Update Feature Attributes

- Right-click on the **Demo** layer and select **Open Attribute Table**
 - Use the bottom-right icons to adjust the view style
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- Modify attribute values as needed
- Press `ctrl+S` to save

Add an Attribute ("desc") to the Features

- Right-click on the **Demo** layer and select **Open Attribute Table**

- Enable editing
- Press `ctrl+V` to paste a new attribute (a new field) button in the toolbar

Hands-on QGIS - Edit fields

Update Feature Attributes

- Right-click on the **Demo** layer and select **Open Attribute Table**
 - Use the bottom-right icons to adjust the view style
- Press **ctrl+E** to enable table editing (or click the *Pencil* icon)
- Modify attribute values as needed
- Press **ctrl+S** to save

Add an Attribute ("desc") to the Features

- Right-click on the **Demo** layer and select **Open Attribute Table**
 - Enable editing
 - Press **ctrl+N** to add a new field (or find the "New Field" button in the toolbar)
 - Set the name and type (e.g. "desc" or type Text)
 - Click OK

Hands-on QGIS - Edit fields

Update Feature Attributes

- Right-click on the **Demo** layer and select **Open Attribute Table**
 - Use the bottom-right icons to adjust the view style
- Press `ctrl+E` to enable table editing (or click the *Pencil* icon)
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- Press `ctrl+S` to save

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 - Press `ctrl+N` to add a new field (or find the "New Field" button in the toolbar)
 - Set the name and type (e.g. "desc" or type Text)
 - Click **OK**

Hands-on QGIS - Edit fields

Update Feature Attributes

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 - Use the bottom-right icons to adjust the view style
- Press `ctrl+E` to enable table editing (or click the *Pencil* icon)
- Modify attribute values as needed
- Press `ctrl+S` to save

Add an Attribute ("desc") to the Features

- Right-click on the **Demo** layer and select **Open Attribute Table**
 - Enable editing
 - Press `ctrl+W` to add a new field (or find the "New Field" button in the toolbar)
 - Set the name and type (e.g., "desc" of type Text)
 - Click **OK**

Hands-on QGIS - Edit fields

Update Feature Attributes

- Right-click on the **Demo** layer and select **Open Attribute Table**
 - Use the bottom-right icons to adjust the view style
- Press `ctrl+E` to enable table editing (or click the *Pencil* icon)
- Modify attribute values as needed
- Press `ctrl+S` to save

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 - Click **OK**

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 - Click **OK**

Hands-on QGIS - Process fields

For each point compute a new field with distance from Rome in degrees

- Select a layer and click the **Open Attribute Table** button in the toolbar
- Click CTRL+I or the abacus icon in the attribute table window
- Input a name for the new field (e.g., *Lat*)
- Choose a type for the field (e.g., *Decimal Number*)
- Enter the following expression in the Expression box

```
distance(@geometry, 'Rome')
```

- The distance function takes two inputs
- Note: to see meters output, it is needed to transform from EPSG:4326 to EPSG:3857, using the transform tool

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- Input a name for the new field (e.g., *Lat*)
- Choose a type for the field (e.g., *Decimal Number*)
- Enter the following formula in the *Expression* box

```
distance(@geometry, make_point(12.5763, 41.8919))
```

- The distance function takes two points
- Note: to see meters values, it is necessary to change the CRS from EPSG:4326 to EPSG:3857, using the transform tool

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- Enter the following formula in the *Expression* box

```
distance(@geometry, make_point(12.5, 41.9))
```

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- Choose a type for the field (e.g., *Decimal Number*)
- Enter the following formula in the *Expression* box

```
distance(@geometry, make_point(12.5, 41.9))
```

- The distance function takes two points
 - @geometry is the only one corresponding to the current table
 - make_point(12.5, 41.9) is the coordinates of Rome (e.g., lat)
- Note: to see meters outputs, it is necessary to change from EPSG:4326 to EPSG:3857, using the transform tool

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```
distance(@geometry, make_point(12.5, 41.9))
```

- The distance function takes two points
 - @geometry is the one corresponding to the row in the table
 - make_point(12.5, 41.9) corresponds to Rome (long,lat)
- Note: to see meters conversion is needed, from EPSG:4326 to EPSG:3857, using the transform function

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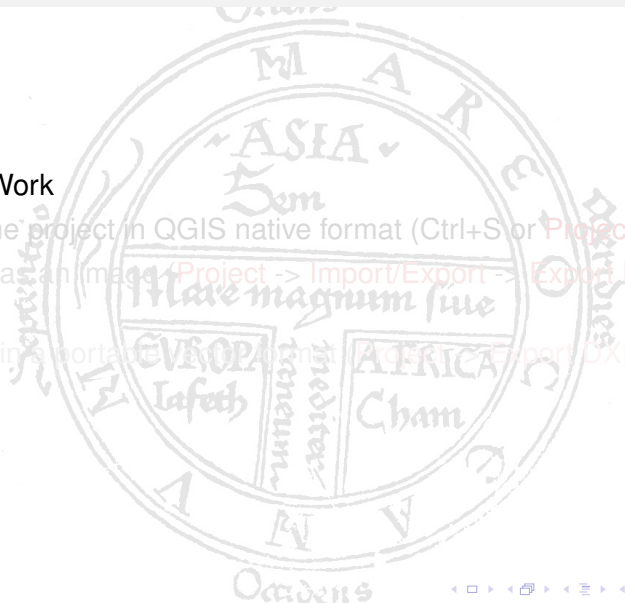
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Hands-on QGIS - Save or export

Save Your Work

- Save the project in QGIS native format (Ctrl+S or **Project -> Save**)
- Export as an image (**Project -> Import/Export -> Export Map to Image**)
- Export in a portable vector format (**Project -> Export DXF**)



Hands-on QGIS - Save or export

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GUI Toolbar Icons (Quick Reference)



Data source manager toolbar



Digitizing toolbar



Attributes toolbar

Lab Activity

- (Basic) North of La Spezia, there is a region called "Cinque Terre". The name comes from five fishing villages: Corniglia, Manarola, Vernazza, Monterosso, and Riomaggiore. Set a Point for each village and display a label with its name on the map.
- (Intermediate) Draw a sea route visiting all the villages, starting from Levanto (another small town to the north). For this create a new LineString vector, enable editing, select Add Linear Element and mark waypoints with the left button. Right button to close the LineString.
- (Intermediate) Convert the line to a new layer of vertices using **Vector -> Geometry Tools -> Extract Vertices**
- (Advanced) Compute the longitude and latitude of these points, and label each one with a string "(long, lat)" using the **concat** function in the calculator.