Example of a Local Application: QGIS

Summer School on Digital Humanities
Course material available at
https://github.com/AugustoCiuffoletti/DHSS_2025

Augusto Ciuffoletti

8 giugno 2025

Example of a Local Application: QGIS

- The user installs a GIS application on the PC

User

- In this scenario, the web is a tool for exchanging data
  - but ...
- Quantum GIS (QGIS) is an open source GIS application

- Runs on Windows, Linux and MacOS

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  - First released in 2002
  - Here we use version 3.4.x (Madeira)
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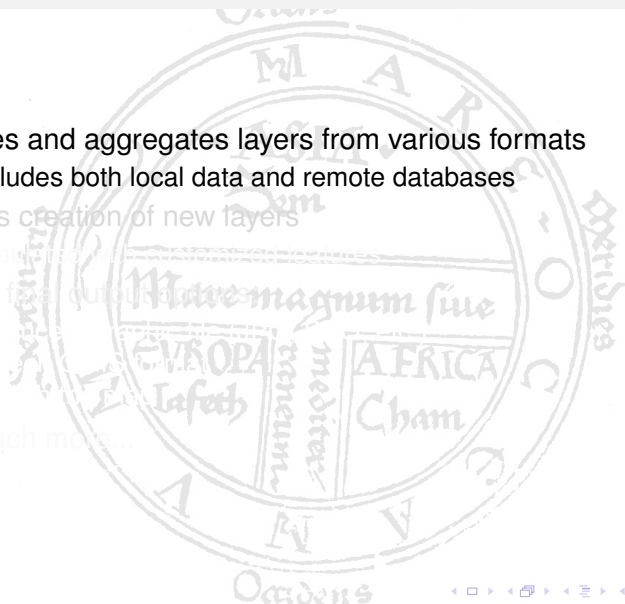- Runs on Windows, Linux, and macOS

QGIS Operation

- Acquires and aggregates layers from various formats
  - Includes both local data and remote databases
- Enables creation of new layers
- Among few ...
- And much more...

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Step-by-Step QGIS Tutorial - 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

- Use the exploration or selection

Understanding the Raster Layer

- The map is the background layer

- Various providers of raster data

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Understanding the Raster Layer

- The map is now displayed as a raster layer
  - Composed of multiple tiles of a certain size
  - Certain bands within the tile
- Various providers of raster data

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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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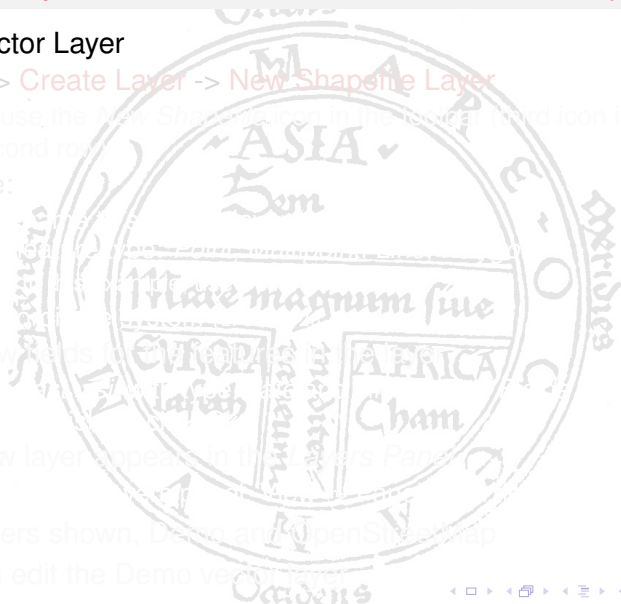
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Step-by-Step QGIS Tutorial - Add a Vector Layer

Define a Vector Layer

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

- Add new fields to 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 file name and location for the shapefile (usually the project directory)
  - a geometry type
- Add new fields to the layer
- The new layer appears in the *Layers Panel*
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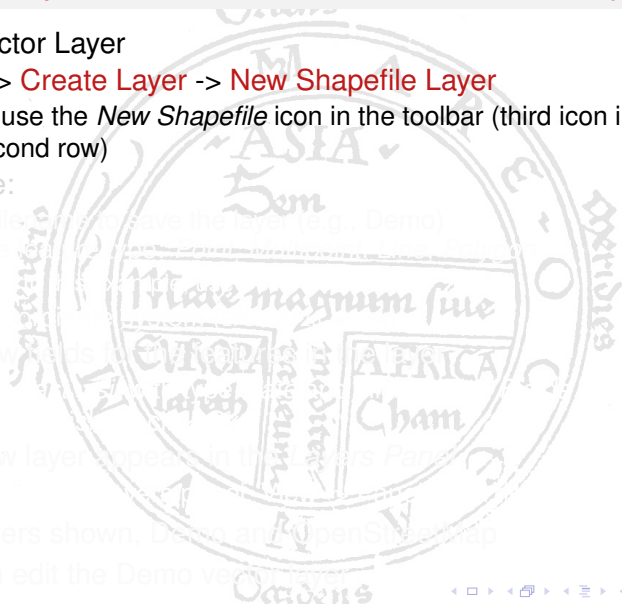 - Or use the *New Shapefile* icon in the toolbar (third icon in the second row)
- Choose:
  - A file where to save the layer (e.g., Demo)
  - The geometry type...
  - ...
- Add new fields to...
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    - Or use the *New Shapefile* icon in the toolbar (third 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 (default CRS)
- Add new fields to the layer
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- 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 fields to the layer
- The new layer appears in the *Layers Panel*
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    - The feature type: *Point*, *Multipoint*, *Line*, *Polygon*
        - In this example, use *Point*
    - A coordinate system (EPSG:4326 WGS84)
- Add new fields for the layer data

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    - A coordinate system (EPSG:4326 WGS84)
- Add new fields for the features in the layer
    - e.g. *Level*, as an integer number, to add to the field list
    - *Value* text Add to fields list
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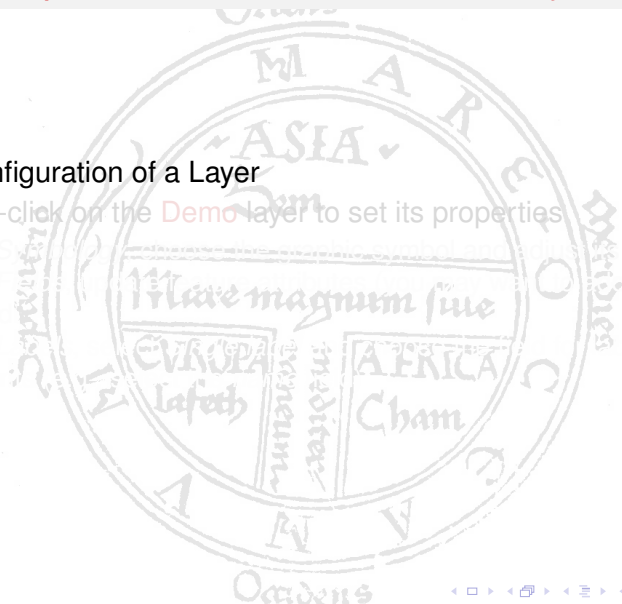
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Step-by-Step QGIS Tutorial - Refine the layer definition

Further Configuration of a Layer

- Double-click on the Demo layer to set its properties
    - In S...
    - In...
        nem...
    - ...

Augusto Ciuffoletti — Course material available from course site: https://bit.ly/dt4h-gis

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 *name* field)
  - In *Labels*, select *single* and *name* field for labeling the points (e.g. select the *name* field)

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Step-by-Step QGIS Tutorial - Working with points

Populate a Vector Layer (with Points)

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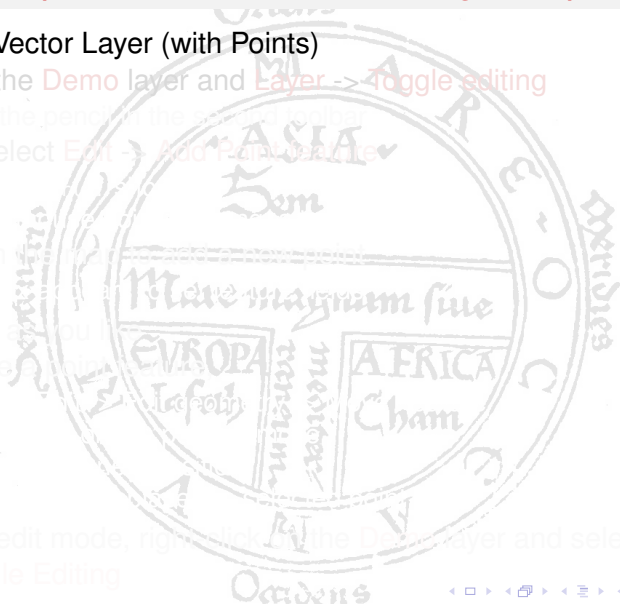 - Or the pencil in the second toolbar
- Then select Edit -> Add Point feature

- Click on

- Repeat as you
- To move a point

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

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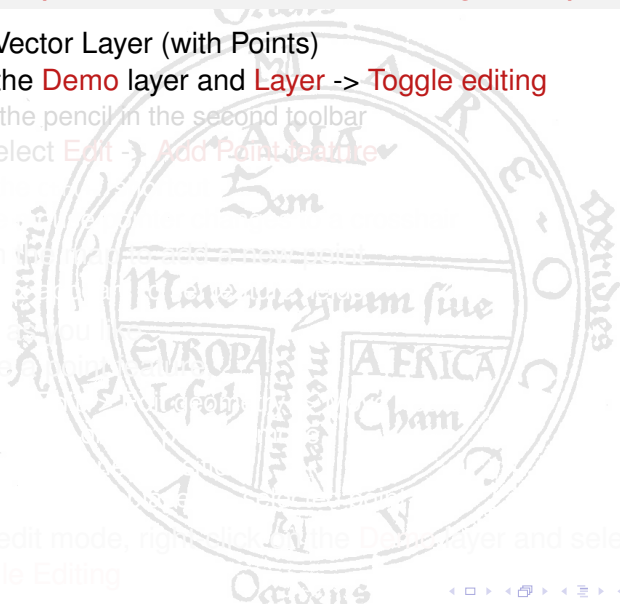- Then select Edit -> Add Point Feature

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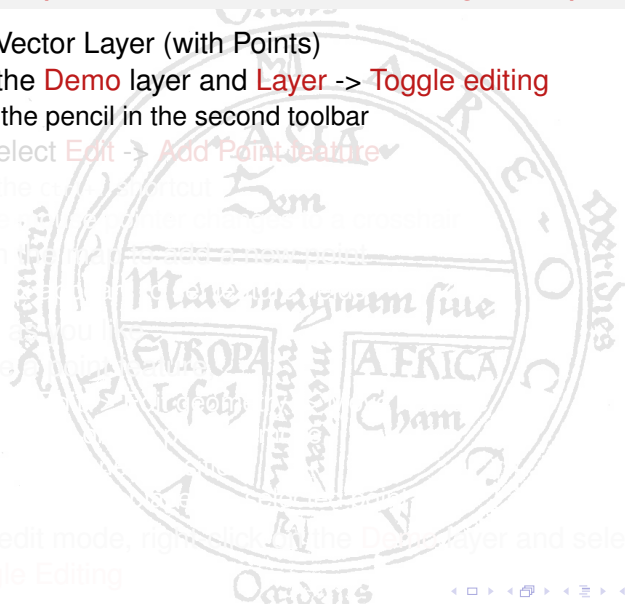
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- Then select Edit -> Add Point feature
    - or the corresponding shortcut
    - This changes the cursor shape to a crosshair
- Click on the map
- Repeat as you want
- To move a point ...

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    - The mouse pointer changes to a crosshair
- Click on the map area to add a new point
- Repeat as you
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    - The mouse pointer changes to a crosshair
- Click on the map to add a new point
    - A box to add a name
- Repeat as you like
- To move a point
- To exit edit mode, right click on the Demo layer and select Layer -> Toggle Editing

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, drag it

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

Step-by-Step QGIS Tutorial - Working with points

Populate a Vector Layer (with Points)

- Select the Demo layer and Layer -> Toggle editing
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- Then select Edit -> Add Point feature
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- Click on the map to add a new point
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- Repeat as you like
- To move a point feature

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Step-by-Step QGIS Tutorial - Working with points

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

Step-by-Step QGIS Tutorial - Working with points

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    - 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,
    - menu Edit -> Edit geometry -> Move Feature
    - right click on the point to move
    - drag to the new position
    - left click to distribute the move
- To exit edit mode, right click on the Demo layer and select Layer -> Toggle Editing

Step-by-Step QGIS Tutorial - Working with points

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- Repeat as you like
- To move a point feature,
  - menu Edit -> Edit geometry -> Move Feature
  - right click on the point to move
  - drag to the new position
  - left click to displace the selected point
- To exit edit mode, right click on the Demo layer and select Layer -> Toggle Editing

Step-by-Step QGIS Tutorial - Working with points

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    - drag to the new position
    - left click to displace the selected point
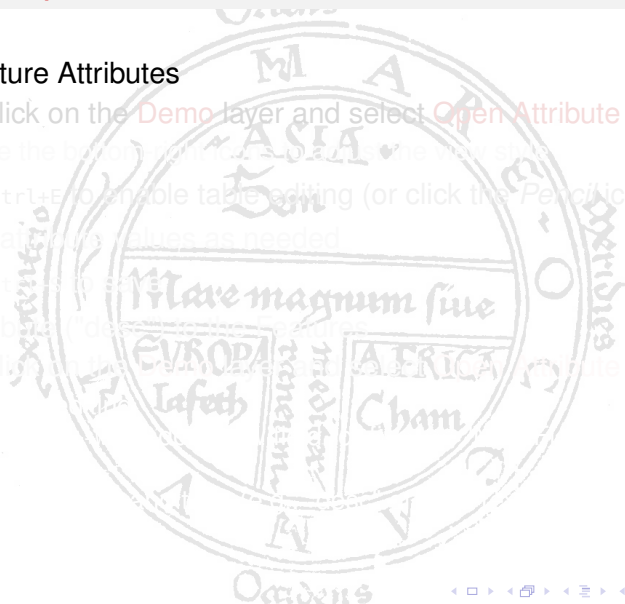- To exit edit mode, right-click on the Demo layer and select Layer -> Toggle Editing

Step-by-Step QGIS Tutorial - Edit fields

Update Feature Attributes

- Right-click on the Demo layer and select Open Attribute Table
  - Use the button or the shortcut at the top side
- Press ctrl+E to enable table editing (or click the *Pencil* icon)
- Modify attribute values as needed
- Press ctrl+s to save changes

Add an Attribute "description" to the features

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

Step-by-Step QGIS Tutorial - 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 changes to the features
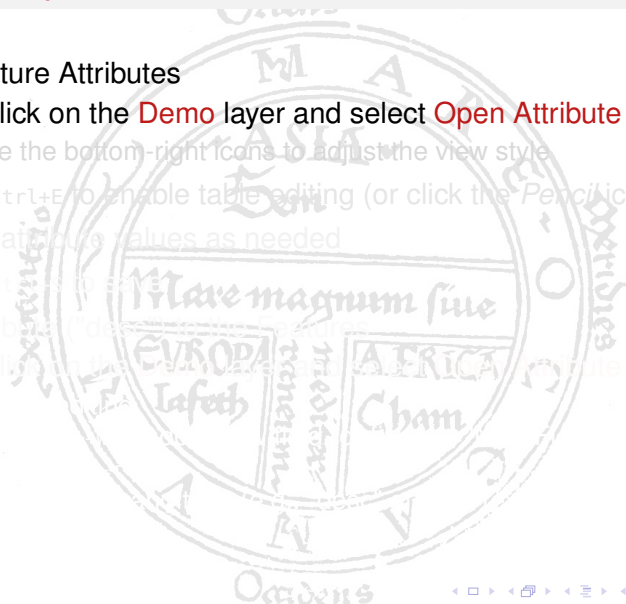
Add an Attribute: "description" to the features

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Step-by-Step QGIS Tutorial - 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 to "describe" features
- Right-click on the layer and select Open Attribute Table

Step-by-Step QGIS Tutorial - 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 ("default") to the Features

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

Step-by-Step QGIS Tutorial - 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 Open Attribute Table

Step-by-Step QGIS Tutorial - 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

Step-by-Step QGIS Tutorial - Edit fields

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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 table
  - Press Ctrl+... to add new field (or press "add field" button in the toolbar)
  - Set the parameters
  - Save it

Step-by-Step QGIS Tutorial - 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+W to add a new field (or find the "New Field" button in the toolbar)
  - Set the name and type (use "desc" of type Text)
  - Click OK

Step-by-Step QGIS Tutorial - 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+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

Step-by-Step QGIS Tutorial - Edit fields

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- Right-click on the Demo layer and select Open Attribute Table
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- Press Ctrl+S to save

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    - 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

Compute Fields with Point Coordinates

- Select a layer and click the *Open Attribute Table* button in the toolbar
- Click CTRL+I of the abacus icon in the attribute table window
- De-select *Only update 1 selected feature*
- Input a new field name
- Choose a type for the new field (e.g. *Decimal number (real)*)
- Enter the appropriate expression to fill the field mask

- Create another field for longitude (e.g. *x_coord* using *x($geometry)*)

Step-by-Step QGIS Tutorial - Process fields

Compute Fields with Point Coordinates

- 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

- De-select *Only update 1 selected feature*

- Input a name for the new field (e.g., *lat*)

- Choose a type for the new field (*Decimal number*)

- Enter the formula *y($geometry)* in the *Expression* text box

- Create another field for longitude (e.g., *lon*) using *x($geometry)*

Step-by-Step QGIS Tutorial - Process fields

Compute Fields with Point Coordinates

- 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
- De-select *Only update 1 selected feature*
- Input a name for the new field (e.g. *utm_lat*)
- Choose a type for the field (e.g. *Decimal Number*)
- Enter the formula *y($geometry)* in the formula box
- Create another field for longitude (e.g. *utm_long* using *x($geometry)*)

Step-by-Step QGIS Tutorial - Process fields

Compute Fields with Point Coordinates

- 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
- De-select *Only update 1 selected feature*
- Input a name for the new field (e.g. *Lat*)
- Choose a type for the field (e.g. *Decimal Number*)
- Enter the formula *y($geometry)* in the Expression box
- Create another field for longitude (e.g. *Long*) using *x($geometry)*

Compute Fields with Point Coordinates

- Select a layer and click the *Open Attribute Table* button in the toolbar
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- Choose a type for the field (e.g., *Decimal Number*)
- Enter the formula *y($geometry)* in the Expression box
- Create another field for longitude (e.g., *Long*) using *x($geometry)*

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Compute Fields with Point Coordinates

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- De-select *Only update 1 selected feature*
- Input a name for the new field (e.g., *Lat*)
- Choose a type for the field (e.g., *Decimal Number*)
- Enter the formula *y($geometry)* in the *Expression* box
  - Find help on the *y* verb in the *Geometry* drop-down list
  - Ignore the *geom_to_wkt* suggestion in the provider
- Create another field for longitude (e.g., *Long*) using *x($geometry)*

Step-by-Step QGIS Tutorial - Process fields

Compute Fields with Point Coordinates

- 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
- De-select *Only update 1 selected feature*
- Input a name for the new field (e.g., *Lat*)
- Choose a type for the field (e.g., *Decimal Number*)
- Enter the formula *y($geometry)* in the *Expression* box
  - Find help in the list near the Expression box in the "Geometry" drop-down list
  - Ignore the warning about *not adding the field to the provider*
- Create another field for longitude (e.g., *Long*) using *x($geometry)*

Step-by-Step QGIS Tutorial - Process fields

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- Enter the formula *y($geometry)* in the *Expression* box
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- Choose a type for the field (e.g., *Decimal Number*)
- Enter the formula *y($geometry)* in the *Expression* box
  - Find help in the list near the Expression box in the "Geometry" drop-down list
  - Ignore the warning about *not adding the field to the provider*
- Create another field for longitude (e.g., *Long*) using *x($geometry)*

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 format (AutoCAD Export DXF)

Save Your Work

- Save the project in QGIS native format (Ctrl+S or Project -> Save)
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- Export in a portable vector format (Project -> Export DXF)

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- Export in a portable vector format (Project -> Export DXF)

GUI Toolbar Icons (Quick Reference)

Data Source Manager

New Shapefile Layer

Data source manager toolbar

Toggle editing

Add point feature

Digitizing toolbar

Attribute Table

Field Calculator

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 and mark waypoints with the left button. Right button to close the line.

- (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.