



# Make your own GIS service

## Summer School on Digital Humanities

Course material available at

[https://github.com/AugustoCiuffoletti/DHSS\\_2025](https://github.com/AugustoCiuffoletti/DHSS_2025)

Augusto Ciuffoletti

8 giugno 2025

# Make your own GIS service

- We have seen how open services provide many functionalities to
  - produce a live map, with web links and multimedia contents
  - share it with others
  - export the data across tools and other services
- However, we have requirements that do not exactly match an existing service
- In that case, we can create our own web service
- The task is simpler if we use an open source library, *leaflet*
- In this concluding tutorial we scratch the surface of this tool to understand its potential



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- The task is simpler if we use an existing open source library, *leaflet*
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# How to proceed

- The tutorial consists in the step-by-step creation of a simple app that:
  - Displays a map
  - Allow the user to add markers to the map
  - Export the markers as a GeoJSON string
  - Store the data in a database
- The tools we are going to use: the marker library is Stackblitz <https://stackblitz.com/> for JavaScript
- The code for each step is prepared, tested, and modified as a Stackblitz project
- The link to each project is in the title of each slide, and in the course website page dedicated to this topic.

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# Using the Stackblitz IDE

- Follow the [project link](#) for the first step
- In the right frame you see the preview of your service, showing a map
  - the URL of the preview is functional: try it!
- In the left frame there is the project content
- The selected file shows in the center frame



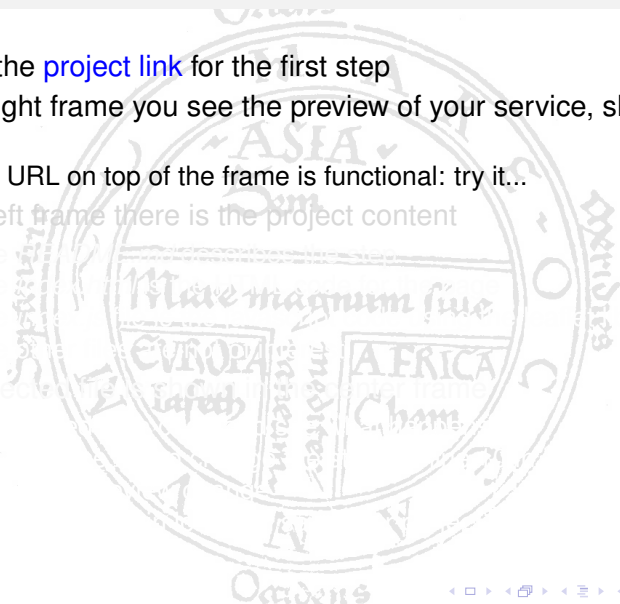
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  - The `README.md` describes the step
  - The `index.html` is the HTML code for the page
  - The `index.js` file is the javascript code using the leaflet library
  - The other files are the CSS and other resources
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  - You can edit the code and see the changes in real time
  - For instance, try to change the map center in *index.html* and notice the preview

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  - For instance, try to change the string in line 10 in *index.html* and notice the preview change
  - Your edits remain local. To save your project you should register on Stackblitz

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# Step 1: the background (project)

- The first step in our tutorial consists of using the *Leaflet* library to display an OpenStreetMap raster
- The reference to the library is in the *package-lock* file
- In the HTML file.

- The index file contains the description of our map
- The capital state is the capital of our map
- So we create the map with two markers

- Next we define the source for the tiles, which is *OpenStreetMap*

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- The reference to the library is in the *package-lock* file
- In the HTML file:

- a head element with the CSS for the *Leaflet* library

- a body

- The index file contains the code for our map

- The capital state is a map of the world

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  - a head element with the CSS for the *Leaflet* library
  - a div element for the map (its id is *mapid*)
- The index.js file contains the JavaScript code of our map
- The capital state is a *Leaflet* map
- So we create a *Leaflet* map with two layers
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- The index.js file contains the javascript code of our map
- The capital stands for the raster class
- So we create the Leaflet map
- Next we define the source for the tiles, which is *OpenStreetMap*

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- The capital L stands for the *Leaflet* class
- So we create a map with two parameters
  - the id of the DOM element where we want to put the map (our mapid)
  - A JavaScript object with a position (latitude and longitude) as center and zoom level
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- The capital L stands for the *Leaflet* class
- So we create a map with two parameters
  - the id of the DOM element hosting the raster (our mapid)
  - A JavaScript object that describes position of map center and zoom level
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# Step 1: Lab activity

- Browse the web to find the coordinates of a place at your choice as the center of the raster
- Modify/remove the zoom factor

## IMPORTANT:

- you **cannot** commit your updates on my repo (Error 403)
- you can *Connect a repository* of your own on GitHub (recommended)
- you can *Save* your updates,
  - but you will lose your work when you switch branch (Discard Changes)
- you can undo updates with Ctrl-z
- you can *Fork* a branch
  - this works on a single branch
- you can clone the whole repository (all branches) in your computer and push it on a new repo

## Step 2: show the coordinates (project)

- When the user clicks on the map an alert appears with the coordinates of the click
- We apply the `on` method to the map to catch click events
  - the first argument of the event we want to capture
  - the function that will be called when the event is captured

## Step 2: show the coordinates (project)

- When the user clicks on the map an alert appears with the coordinates of the click
- We apply the *on* method to the map to catch *click* events
  - the first parameter is the name of the event we want to capture
  - the second parameter is a callback that takes the event description as a parameter
  - the callback displays an alert containing data extracted from the event description
  - the event description is an object
  - we extract the lat and lng values in the latlng field

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  - the event descriptor is an object
  - we extract the `lat` and `lng` fields in the `latlng` field.



## Step 2: Lab activity

- Replace the alert with a popup on the click point
- Instead of the geographical coordinates, print the position of the point in the layer
  - consult <https://leafletjs.com/reference-1.7.1.html#mouseevent>



## Step 3: collect coordinates (project)

- Each click on the map adds a marker, and their coordinates are shown on the page
- The event callback contains the creation of the new marker
  - its position is obtained from the event descriptor
  - the color is a function of the elevation of the point



## Step 3: collect coordinates (project)

- Each click on the map adds a marker, and their coordinates are shown on the page
- The event callback contains the creation of the new marker
  - its position is computed using the `latlng` field in the event descriptor
  - the coordinates are appended to the list in a `div` element of the DOM

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## Step 3: Lab activity

- Display the distance of the point from the center instead of its coordinates
  - consult

<https://leafletjs.com/reference-1.7.1.html#map-conversion-methods>



## Step 4: enumerated markers (project)

- An progressive index is assigned to each new point
- The index is shown in the list and added as a *title* field in the marker definition
  - the title field is automatically displayed when the mouse hovers on the marker
- We add a new global variable
- The event callback increments the variable each time it is run
- The value of *i* is displayed on each line in the list
- The marker constructor takes as a third parameter containing the marker options

## Step 4: enumerated markers (project)

- An progressive index is assigned to each new point
- The index is shown in the list and added as a *title* field in the marker definition
  - the title field is automatically displayed when the mouse hovers on the marker
- We add a new global variable  $n$ 
  - The event callback increments the variable each time it is run
  - The value of  $n$  is displayed on each line in the list
  - The marker constructor now takes a second parameter containing the marker options



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- The index is shown in the list and added as a *title* field in the marker definition
  - the title field is automatically displayed when the mouse hovers on the marker
- We add a new global variable  $n$
- The event callback increments the variable each time it is run
- The value of  $n$  is displayed on each line in the list
- The marker constructor now takes a second parameter containing the marker options
  - among which the title option

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  - among which the `title` option

## Step 4: Lab activity

- Configure the marker as draggable (ignore that the displayed coordinates become inconsistent)
  - consult <https://leafletjs.com/reference-1.7.1.html#marker>
- (advanced) show the coordinates inside the *title* and update them when the marker is dragged
  - consult the same manual page of the previous lab activity

## Step 5: all markers in an array (project)

- Record the markers in an array to have them accessible
  - in the previous steps the marker was a local variable in the callback
- Create an array for the markers
- Push markers in the array
- $n$  index corresponds to array length

## Step 5: all markers in an array (project)

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  - no first element



## Step 5: all markers in an array (project)

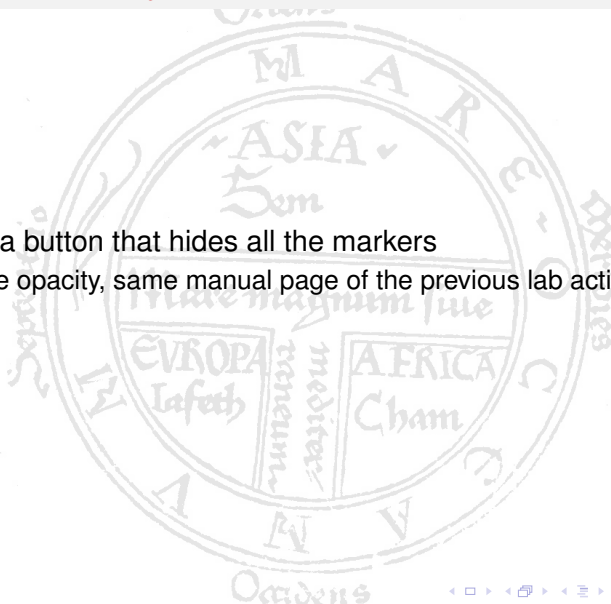
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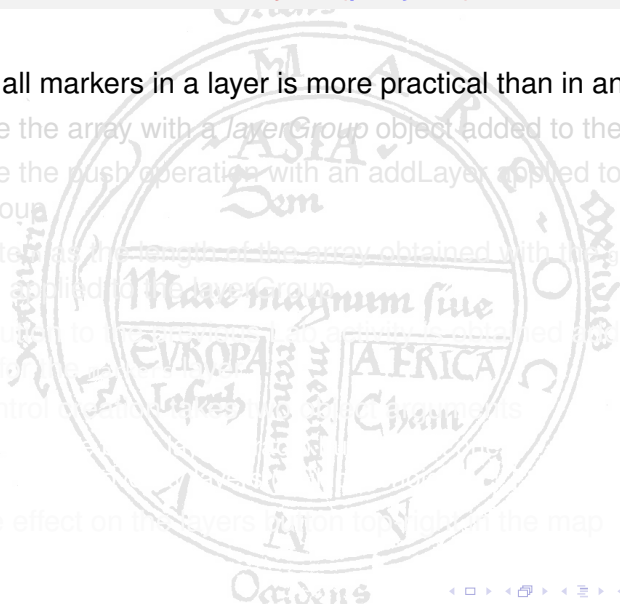
## Step 5: Lab activity

- Create a button that hides all the markers
  - Use opacity, same manual page of the previous lab activity



## Step 6: all markers in a layer (project)

- Having all markers in a layer is more practical than in an array
- Replace the array with a *LayerGroup* object added to the map
- Replace the push operation with an *addLayer* applied to the *layerGroup*
- Compute as the length of the array obtained with the *getLayers* method applied to the *layerGroup*
- The solution to push markers to a *layerGroup* is adding a control for the push button to the map
- The control *addLayer* is added to the map
- See the effect on the layers button top right in the map



## Step 6: all markers in a layer (project)

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- Compute as the length of the array obtained with the *getLayers* method applied to the *layerGroup*
- The solution to the previous Lab activity is obtained adding a control for the markers to the map
- The control displays the markers in the map
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popup to all features in the layer

consult <https://leafletjs.com/reference-1.7.1.html#layergroup>

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## Step 7: GeoJSON serialization (project)

- It is handy to have a standard string representation of a piece of data (serialization)
  - e.g. to store the data in a file
- The GeoJSON representation can be easily transformed into a JSON string, and viceversa
- We want to print in the console the JSON string for our markers
- The `toGeoJSON` method converts the markers layer into a JavaScript object with the GeoJSON format
  - alas, in the console
- The `stringify` method serializes the object as a String object
- The string is finally copied to the console

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## Step 7: Lab activity

- Is there any way to record the *title* field in the JSON string?
- Study the geoJSON format in the console and find a solution
- If needed see :
  - <https://geojson.org/> for geojson syntax
  - <https://leafletjs.com/reference-1.7.1.html#marker> for the toGeoJSON method

## Step 8-10: a map in the cloud

- We want to store our markers in the cloud
- The simplest option is to use a Key-Value service
  - a basic one is the one implemented on MongoDB Atlas (just demonstration, not for public use)
- A *New* button in the interface allows the user to acquire a reserved key (step 8)

(project)

- A *Save* button allows to update the cloud record (after filling the Key box) (step 9)

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- A *Load* button allows to download the cloud record (after filling the Key box) (step 10)

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# Firestore deployment

- For this you need a Google account
- You need first to access the console of the service at <https://console.firebase.google.com/> and add a new project
  - in the following dialog, do not enable Google Analytics
  - observe the warning
- In the Start Wizard window click on the Firebase logo in the left toolbar
- Click on the name of the project (e.g. "my-new-app")
- Finally click on the "Go to project" button
- Your app is now permanently available at that URL

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- In the Stackoltz window click on the firebase logo in the left toolbar
- Click on the name of the project "Stackoltz" or "Stackoltz-2020-01-20-10-10-10"
- Finally click on the "Add Firebase to your app" button
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# Stackblitz interface

- In the right frame we see the preview of our service
  - the URL on top of the screen is functional (try it...)
- In the center frame there is a code editor
- In the left frame there is the project content and github reference
- The left toolbar contains the file explorer and the search bar
- The top toolbar is related to the code editor

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- The top toolbar contains the undo, redo, and other editing tools

# Stackblitz interface

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# One screen development environment

- The project code resides on the Stackblitz Webserver
- The user get access to the project following a web link
- The page displays an editable
- The user interacts with the browser clicking buttons, filling forms and such
- All this is synthesized



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