

Make your own GIS service

Summer School on Digital Humanities

Course material available at

https://github.com/AugustoCiuffoletti/DHSS_2025

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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 may have requirements that do not exactly match an existing service
- In that case we need to code our own web service
- The task is simplified by the existence of a powerful open source library, *leaflet*
- In this concluding tutorial we scratch the surface of this tool to understand its potential

Stackblitz

- The tool we are going to use to practice the *leaflet* library is Stackblitz (<https://stackblitz.com/>)
 - First step, create an account on Stackblitz
- Stackblitz is an online IDE for JavaScript
- Once you log-in it presents you an assortment of different JavaScript platforms
 - e.g. Angular, Vue, React, and also plain JavaScript
- Click on the yellow JavaScript icon and wait until the project is created
- The screen is divided into three columns and toolbars on the top and on the left side of the window

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
 - try to change the string in line 6 and notice the preview change
- In the left frame there is the project content and github reference
- The left toolbar controls the content of the left column
- The top toolbar is for project management

Lab activity

- Take your time to try the above steps and look around the content and the controls

One screen development environment

- The project code resides on the Web server
- The user obtains the code with a HTTP GET on the browser (i.e., visiting the URL)
- The browser runs the JavaScript code and displays the result
- The user interacts with the browser clicking buttons, filling forms and such
- All this is synthesised in the StackBlitz screen
 - using a Web server which is appropriate only for development
 - a real deployment may run on Firebase (third icon in the left toolbar)
 - free plan available, Google account needed

Step by step *Leaflet* tutorial

- The support material for this tutorial runs on Stackblitz
- To use it, start from the project created in the above step:
 - Click on the *Connect repository* button
 - do not fill the New Repository field
 - Select *import an existing repository*
 - ...and ignore the yellow warning
 - Copy the following URL in the *Paste GitHub repository URL* field
 - <https://github.com/AugustoCiuffoletti/leafletExercise>
 - Next click *Import repository*
 - Wait for the project to load

Moving across the tutorial

- Observe the top of the left toolbar
- Below the line with the name of the GitHub repository (AugustoCiuffoletti/leafletExample) you see a line headed by the *branch* icon
- Use this line to navigate through the tutorial steps
- The line should show `master` presently
- Click on it for a list of the tutorials steps
 - select `master` it is not on display
 - to move to a different step just click on it
- In the README.md file you find further comments

Step 0: the background raster

- The first step in our tutorial consists of using the *Leaflet* library to display an OpenStreetMap raster
- To this end we include in the HTML file:
 - a `head` element with the CSS and the JavaScript for *Leaflet*
 - a `div` element for map display (its `id` is `aMap`)
- The `index.js` file contains the JavaScript code of our App
- The capital `L` stands for the *Leaflet* class
- So we apply the global method `map` which takes two parameters
 - the `id` of the DOM element hosting the raster
 - A JavaScript object that describes how the map is displayed
 - We opted for a minimal description with only:
 - the position of map center (the Pisa tower)
 - the zoom level
 - the source of the raster (OpenStreetMaps)

Step 0: 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 loose 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 1: a decorated feature

- We want to draw a point corresponding to the coordinates of the leaning tower truncated at two digits
 - and attach to the point an explanatory popup
- We define variables for the latitude and the longitude of the tower
 - and another two with the truncated values
- The new point is defined (constructed) as an object in the class *Marker* using the computed coordinates
- We apply the *bindPopup* method to the marker to attach the popup
- The *addTo* method is applied to the marker in order to include it in the map, which is the method parameter
- Finally *openPopup* is applied to the marker to display the attached popup

Step 1: Lab activity

- Try to truncate at three and four digits, or to place the marker on the center of the map
- Place the marker in a different place and change the message

Step 2: show the coordinates

- 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 descriptor *e*
 - 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

- 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

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

- 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
 - 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 a row

- 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
 - no need to increment it

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

- 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 *n* 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 layer
- The control creation takes two object arguments
 - One for the base layers (radio button, just one)
 - One for the overlay layers (multiple choice)
- See the effect on the layers button top-right in the map

Step 6: Lab activity

- Add a popup to all features in the layer
 - consult <https://leafletjs.com/reference-1.7.1.html#layergroup>

Step 7: GeoJSON serialization

- 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 this way we lose the *title* field
- The `stringify` method serializes the object as a String object
- The string is finally recorded in the log

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 I 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)
- A *Save* button allows to update the cloud record (after filling the Key box) (step 9)
- A *Load* button allows to download the cloud record (after filling the Key box) (step 10)

Firebase 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 firebase logo, in the upper left corner
- In the Stackblitz window click on the firebase logo in the left toolbar
- Click on the name of your project and next "Deploy"
- Finally click on the "Open Site", or visit <YourProjectName>.firebaseapp.com
- Your app is now permanently available at that URL