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Presentation of the course

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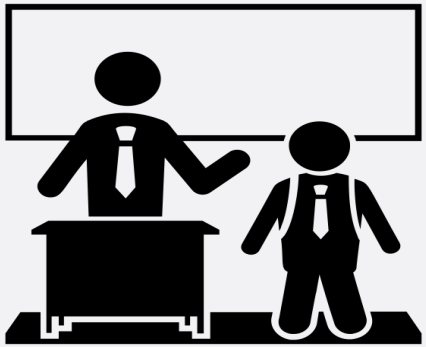
Course Introduction



Objectives Learning

The laboratory aims to provide the necessary basis for learning how to manage, analyze and visualize geospatial data through open source tools (geospatial libraries for python, qgis, R …)

At the end of the course, students will be able to:

- understand the specificity of the geospatial data model
- elaborate and integration of geospatial data (vector and raster)
- spatial statistics analysis
- create maps (also accessible via the web)

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Lecturers

Maurizio Napolitano

FONDAZIONE BRUNO KESSLER

Diego Giuliani

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Hands-on learning

Come in the classroom with your laptop

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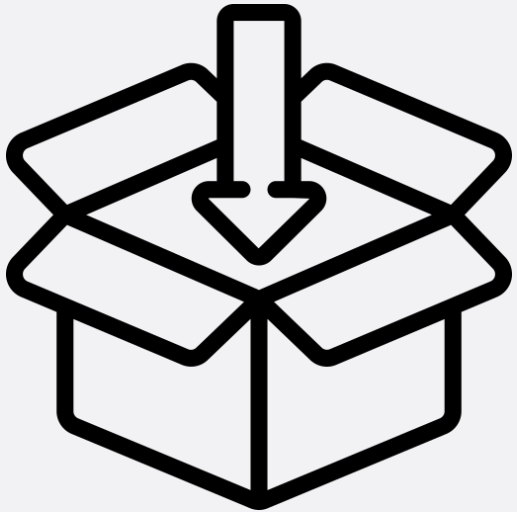
Please start to install everything in your laptop



Python 3.13.*
R 4.4.*+
Java Runtime 17.0.*
A complete installation of QGIS 3.40+
DuckDB 1.1+
GDAL 3.10.*+ completed with all the tools

A development environment for working with Jupyter Notebook and R
We suggest Visual Studio Code

For Windows users it is recommended to install WSL (Windows Subsystem for Linux) so that you can use command line commands freely.

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Support material

Github - lectures by Maurizio Napolitano

https://github.com/napo/geospatialcourse2025

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final evaluation

Each student will be required to deliver a **report** and **interactive map(s)** through which to show all the concepts learned during the course by choosing a specific theme of **geospatial analysis**

Lecturers will offer a list of potential works to implement.
All the students are free of suggest some ideas.

The **work** must **include everything** necessary to **allow** the **reproducibility**

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Schema for the final report

1. Research question
2. Description of the data
3. Data analysis oriented
4. Conclusions
5. References

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Schema for the final report

1. Specification of a research question (abstract)

The data analysis has to be performed according to a clear research question supported by some scientific literature and should concern a well-defined geographical area.
The research question does not necessarily need to be original, it is possible to replicate an existing study for a different geographical context.

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Schema for the final report

2. Description of data

Metadata and sources of the datasets used for the analysis should be provided, as well as any possible restriction of use.
For any dataset, an exploratory preliminary analysis showing why it is useful for the project should be performed. It is also important to clarify which data cleaning and wrangling operations have been used.

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Schema for the final report

3. Data analysis oriented by the research question

This section should illustrate all the analyses that have been made to empirically validate the research question. All the results, tables, maps and graphs should be reported here.

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4. Conclusions

Interpretation of the main findings and implication and discussion on how they relate to the research question.

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Schema for the final report

5. Codes, scripts, softwares

All the codes written to conduct the project have to be submitted with the report. It can be integrated in the report's text (for example through jupyter notebook or R markdown) or not.
The work should be done using one or more of the tools shown during the lectures (Python, R, QGIS, gdal, duckdb, spatialite …).
For R and Python, it is important to list the employed libraries, together with their version number and, in case, installation instructions.
In the case of softwares with a user interface, (e.g. QGIS), the basic sequence of commands needs to be listed.
It is essential to put the lecturers in the position to reproduce the steps proposed by the delivered project work.

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Schema for the final report

IMPORTANT NOTES

The report can be prepared as a PDF file or a Notebook and should be submitted by email or providing a link to a repository (such as github).

Extra work, such as the application of methodologies that are not treated during the course or the creation of websites, is welcome but it will not have a great effect on the final mark.

Group works are not allowed.

At the end of the course, the lecturers, or some companies interested in offering internship programs, will propose some research questions.

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Interactive Map(s)

Each project must include at least one interactive web map that helps readers investigate and validate the conclusions reached through the report analysis.

The map should not be decorative: it must expose key variables, spatial patterns, and uncertainties so users can ask “what if…?” and drill down.

Filters or controls (e.g., category/threshold sliders, time or scenario selector)

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Traces for Exam

Analyzing key influences on Airbnb pricing

Assessing the determinant factors of Airbnb's prices using spatial regression models.
The analysis can focus on a specific city or region.
Airbnb data: https://insideairbnb.com/get-the-data/
Some inspiring examples:
https://link.springer.com/article/10.1007/s00168-021-01064-z
https://www.sciencedirect.com/science/article/pii/S0261517719301797

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Traces for Exam

Climate justice and socio-economic vulnerability at local scale

Analyse climate justice at sub-municipal level by exploring the relationship between socio-economic vulnerability and climate-related or environmental indicators.
The analysis should use the ISTAT Socio-Economic Distress Index (IDISE, 2021) and one or more environmental or climate datasets.
Suggestions:
data: sub-municipal Socio-Economic Distress Index (IDISE, 2021)
paper: Investigating Social Vulnerability to Extreme Heat: Heat Islands and Climate Shelters in Urban Contexts: The Case of Bologna.

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Traces for Exam

Spatial analysis of crime

The analysis can focus on the determinants of crime or on the impact of crime on other dimensions.
Some inspiring examples:
https://ica-proc.copernicus.org/articles/4/5/2021/
https://www.emerald.com/insight/content/doi/10.1108/JES-07-2014-0121
Istat crime data at province level
https://esploradati.istat.it/databrowser/#/en/dw/categories/IT1,Z0840JUS,1.0/JUS_CRIMINAL/DCCV_DELITTIPS/IT1,73_67_DF_DCCV_DELITTIPS_1,1.0

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Traces for Exam

Spatial dependence in voting behaviour

Analysing the spatial distribution of voting patterns.
The analysis can focus on the statistical association between regional electoral outcomes and some characteristics of the regions.
Some inspiring examples:
https://onlinelibrary.wiley.com/doi/10.1111/1467-9477.12268
Data:
Trento mayoral elections 2025
https://github.com/napo/trentonelseggio2025/tree/main/data
Italian electoral data
https://elezioni.interno.gov.it/

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Traces for Exam

Measure street walkability and bikeability of a city

Analyze the street network of a given city to evaluate its walkability and bikeability. Use available spatial data to calculate metrics such as sidewalk coverage, street connectivity, slope, and bike lane presence. Classify different neighborhoods based on their levels of walkability and bikeability.

Some inspiring examples

https://github.com/eemilhaa/walkability-analysis

https://transformtransport.org/research/urban-mobility-metrics/walk-score-toolkit-urban-walkability-analytics/

https://www.sciencedirect.com/science/article/pii/S221414052200158X

https://heigit.org/analyzing-bikeability/

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Traces for Exam

Public transport accessibility, reliability and socio-spatial inequality

Analyse public transport accessibility using GTFS data, focusing on how travel time inaccuracy and variability affect spatial patterns of accessibility and socio-spatial inequalities.
The analysis may compare scheduled travel times with alternative assumptions on reliability or variability and discuss implications for equity.

GTFS public transport data
Socio-economic data (e.g. census or deprivation indicators)
Evaluating the impact of public transport travel time inaccuracy and variability on socio-spatial inequalities in accessibility, Journal of Transport Geography

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Traces for Exam

Geospatial analysis of urban real estate markets

Analyse spatial patterns of housing prices and their determinants using georeferenced real estate data and GIS methods at city level.
The analysis may focus on one or more Italian cities and explore spatial variability, clustering, or relationships with urban, social or environmental factors.

Data:
OMI real estate market data
Urban boundaries, census or environmental datasets

Reference:
Monitoring and Analysis of the Real Estate Market in a Social Perspective, Sustainability.