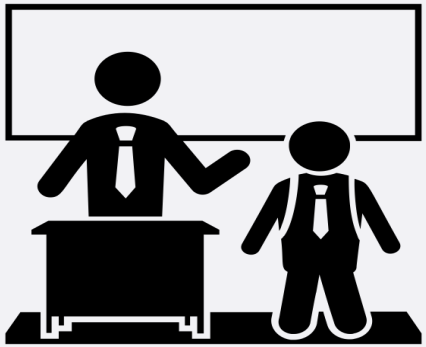
UNIVERSITY OF TRENTO

Presentation of the course

Maurizio Napolitano
(napolitano@fbk.eu)

UNIVERSITY OF TRENTO

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)

UNIVERSITY OF TRENTO

Lecturers

Maurizio Napolitano

FONDAZIONE BRUNO KESSLER

Diego Giuliani

UNIVERSITY OF TRENTO

UNIVERSITY OF TRENTO

Lectures

Every Friday from 20 September to 15 November 2024
Department of Sociology and Social Research - University of Trento
Room 12BM
All official communications will be through the UNITN teaching space

1.1 20/09/24 - Lecture 1

Lecturer: Maurizio Napolitano
Geospatial vector data
- Course introduction
- The basics of geographic data
- Vector data and projections

1.2 27/09/24 - Lecture 2

Lecturer: Maurizio Napolitano
Geospatial vector data
- Solutions to Exercises
- Spatial relations and operation
- Spatial SQL

1.3 04/10/24 - Lecture 3

Lecturer: Maurizio Napolitano
Geospatial vector data
- Solutions to Exercises
- Sources of vector data
- Use of OpenStreetmap data

1.4 06/10/24 - Lecture 4

Lecturer: Diego Giuliani
Spatial statistics
- Spatial dependence and spatial
- Spatial weight matrix
- Spatial regression

1.5 11/10/24 - Lecture 5

Lecturer: Diego Giuliani
Spatial statistics
- Spatially continuous variables
- Spatial interpolation
- Geostatistics

1.6 18/10/24 - Lecture 6

Lecturer: Diego Giuliani
Spatial statistics
- Spatial point pattern data
- Point processes
- Point pattern analysis

1.7 25/10/24 - Lecture 7

Lecturer: Maurizio Napolitano
Analysis of flow data
- Solutions to Exercises
- Network analysis
- Analysis of GPX data

1.8 08/11/24 - Lecture 8

Lecturer: Maurizio Napolitano
Raster data
- Solutions to Exercises
- Basic operations on raster data
- Raster data and vector data

1.9 15/11/24 - Lecture 9

Lecturers: Maurizio Napolitano and Diego Giuliani
Representation of geospatial data
- Solutions to Exercises
- Important caveats about the visualization of

Preparation of the final project for the exam
- Presentation of an example of final project

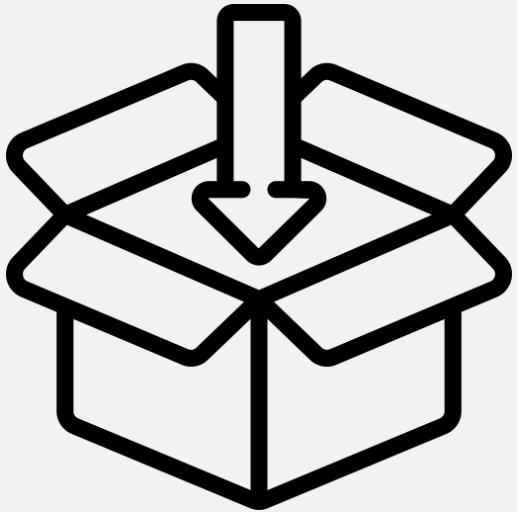
UNIVERSITY OF TRENTO

Hands-on learning

Come in the classroom with your laptop

UNIVERSITY OF TRENTO

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.

UNIVERSITY OF TRENTO

Support material

Github - lectures by Maurizio Napolitano

https://github.com/napo/geospatialcourse2025

UNIVERSITY OF TRENTO

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**

UNIVERSITY OF TRENTO

Schema for the final report

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

UNIVERSITY OF TRENTO

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.

UNIVERSITY OF TRENTO

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.

UNIVERSITY OF TRENTO

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.

UNIVERSITY OF TRENTO

Schema for the final report

4. Conclusions

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

UNIVERSITY OF TRENTO

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.

UNIVERSITY OF TRENTO

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.

UNIVERSITY OF TRENTO

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)