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# Geographic Information Systems 2019-2020
# Lab Project

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# Enhanced Pedestrian Level of Service (PLoS): Data Collection, Processing and Visualization

- Background: Walkability is a critical concern of citizens in living their urban spaces. There is often a lack of accurate and up-to-date base data and tools to compute walkability indexes, because their collection, processing, and visualization are labor-intensive and expensive. By combining GIS technologies, it is possible to deploy effective applications that are useful to assess, monitor, and inform on the walkability quality of cities.

- Tools:
  - EpiCollect
  - QGIS
  - GeoServer
  - OpenLayers

# Enhanced Pedestrian Level of Service (PLoS): Data Collection, Processing and Visualization

- Base Information:
  - The working area is Milan Zone 9 (Municipio 9).
  - Five areas within Zone 9 have been identified by Systematica and divided into two sub-areas each. Each sub-area corresponds to approximately 5 km of roads.
  - Groups composed of 3 or 4 students will be created.
  - Each group will get one sub-area to collect data inside.
  - On BeeP there is a folder for each group including the road network layer (shapefile) of the assigned sub-area. The folder will be named with your group name (e.g. Group 1, Group 2, etc.).
  - The road network layer contains already some indicators to compute the PLoS provided by Systematica.
  - Missing indicators have to be computed by means of field data collection.
  - Detailed information on data to be collected can be found in the Systematica seminar slides.
  - Insight on data processing and visualization will be introduced by the tutors along with the Lab classes. However, students are required to be accurate, creative and as much as possible autonomous in carrying out the Lab work.

# Enhanced Pedestrian Level of Service (PLoS): Data Collection, Processing and Visualization

- STEP 1—Collect Data
  - Create an account on https://five.epicollect.net. Download the **EpiCollect application** on your mobile phone.
  - Download the data collection form of **gislab-2019-plos** project. Each person must contribute to data collection—more detailed the collected data the better.
  - During the field survey, besides enabling the GPS and collection coordinates, you are required to indicate a measurement and optionally add a comment and a picture.
  - Raw collected data will consist of geolocated points that can be downloaded from the EpiCollect website in CSV format.
  - Warning: You must inform the tutors about your EpiCollect login mail address to be able to download the form.

# Enhanced Pedestrian Level of Service (PLoS): Data Collection, Processing and Visualization

- STEP 2— Data Processing
  - Collected points have to be processed by means of a desktop GIS (e.g. QGIS).
  - The processing has to be conceived for enriching each geometry of the road network layer with missing indicators.
  - Operations such as *buffer*, *intersection* and *attribute table manipulation* have to be performed in order to:
    - associate each collected point to the corresponding road network geometry,
    - aggregate multiple point measurements (e.g. by means of a count, average, etc.) to compute a single indicator for each road network geometry.
  - The expected output consists of a copy of the original road network layer containing all the indicators as attributes.
  - An Enhanced PLoS score has to be computed starting from these attributes for each geometry of the road network layer.

# Enhanced Pedestrian Level of Service (PLoS): Data Collection, Processing and Visualization

- STEP 3—Develop a website and Web GIS
  - Develop a Web GIS that has
    - at least three different base maps,
    - all the controls shown in the lesson,
    - two road networks that represent the original and enhanced PLoS. The visualization of the results of the two calculations is up to you.

  - Optionally, the collected points can be visualized on the map. Each point possibly can be queried. The collected data is in CSV format. You can import the file in QGIS, export it as shapefile, import it in GeoServer, use the data with WFS.

  - Develop a website with at least two HTML pages explaining the project, the technologies and data used, and the results achieved. The website must be linked to the Web GIS. The content of the web pages should ideally be clear and effective, i.e., it should explain the choices you made, the options you set, the problems you had, etc. Use figures and screenshots in order to illustrate your work better.

# Enhanced Pedestrian Level of Service (PLoS), Data Collection, Processing and Visualization

- Deliverables: collected data, enriched road network layer, website, Web GIS
  If your data and code are published on GitHub, it will be judged positively.

- Deadline:
  Data and code have to be delivered ONE WEEK BEFORE THE EXAM.
  This lab assignment is valid only for the course year 2019-2020.

- Groups:
  Form groups of (possibly) four people. Arrangement of groups may be redefined by the tutors to accommodate the workload best. Data collection areas will be assigned to each group by the tutors.
  Inform about your group and the email address you used to sign up at EpiCollect to candaneylul.kilsedar@polimi.it until 19/11/2018.

- Additional technical information will be given in the lab on the 25th of November. Written guidelines for data collection and enhanced PLoS computation will be provided on this date.

# Data Processing Guidelines

- The proposed exercise introduces one sample strategy to process collected data and enrich the road network layer with missing indicators

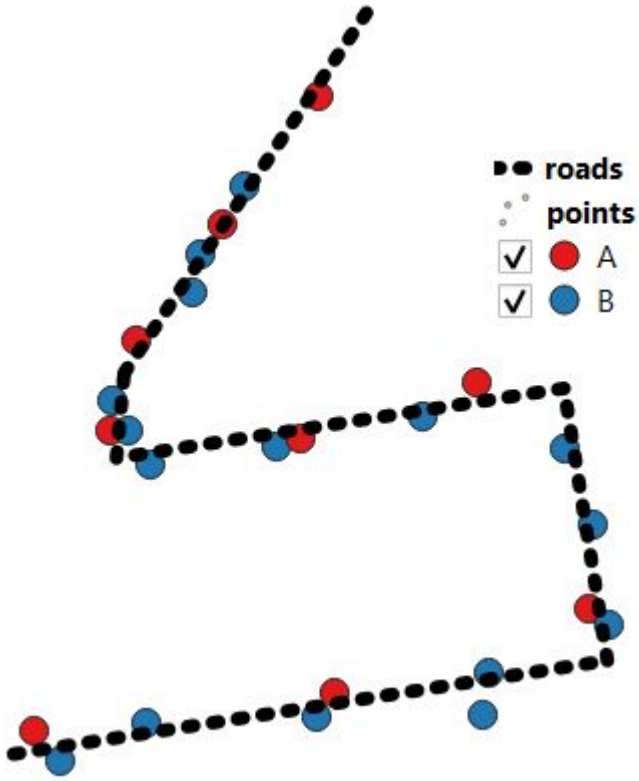
1) Sample data consist of:

   a) **roads.shp** -> a multiline layer with a unique ID (id_road) associated to each line

| | id_road |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |
| 5 | 5 |

   b) **points.shp** -> a multipoint layer with with a unique ID (*id_point*), a typology (*type*) and a measure (*measure*) associated to each point

| | type | measure | id_point |
|---|---|---|---|
| 1 | A | 3,50 | 1 |
| 2 | B | 1,00 | 2 |
| 3 | B | 1,00 | 3 |
| 4 | B | 1,00 | 4 |
| 5 | A | 3,20 | 5 |



# Data Processing Guidelines

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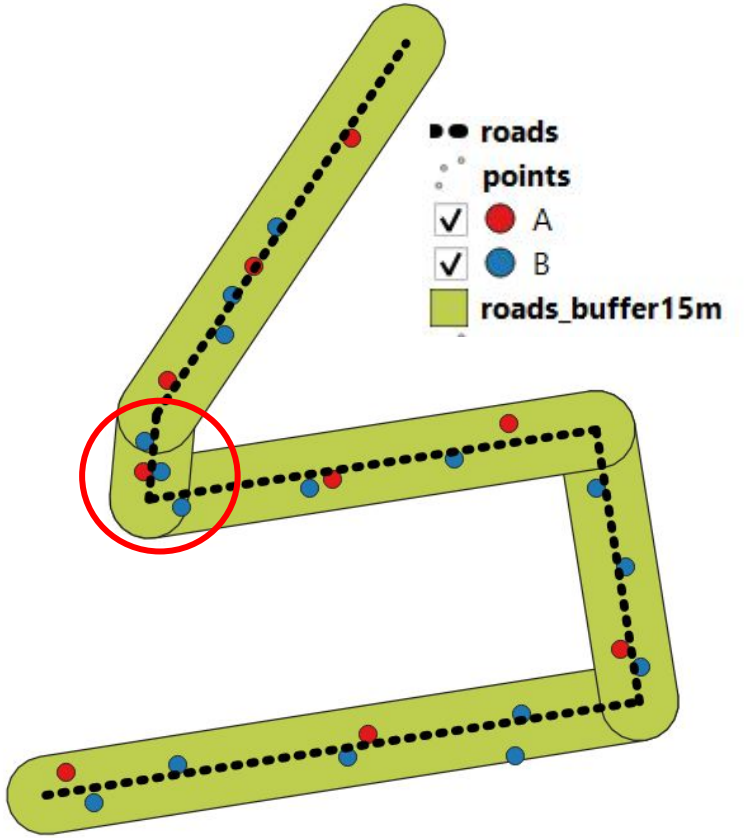
2) The first step aims at matching each point with its corresponding road. This can be achieved by combining a buffer operation of the roads layer with a spatial join operation

   - Compute a *Buffer* around the roads of sufficient size cover all points. If for some point you recognize that the overlapping buffer does not correspond to the belonging road (red circle). You may move the point to fix this issue.



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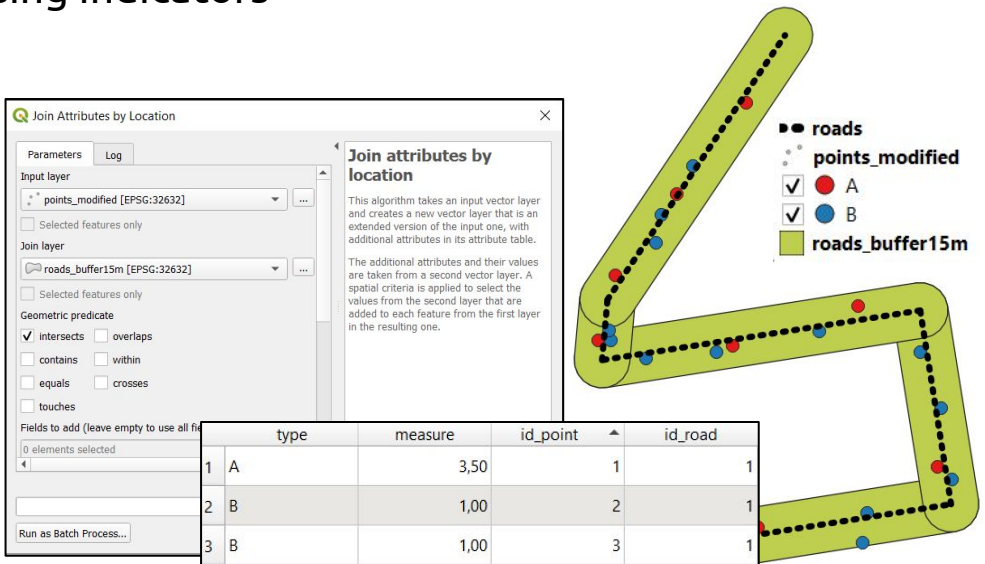
   - Once the points are properly placed, use the *Join Attribute by Location* QGIS processing tool to assign to each point the corresponding road using their IDs.

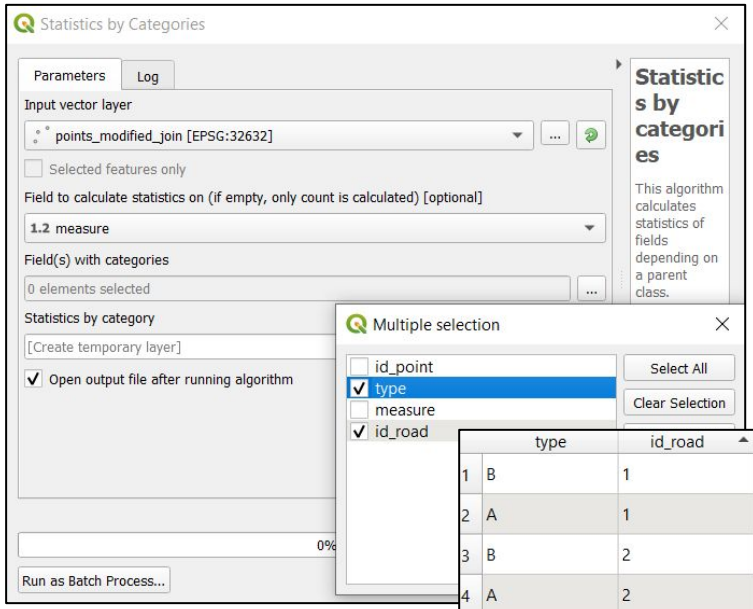



| | type | measure | id_point | id_road |
|---|---|---|---|---|
| 1 | A | 3,50 | 1 | 1 |
| 2 | B | 1,00 | 2 | 1 |
| 3 | B | 1,00 | 3 | 1 |
| 4 | B | 1,00 | 4 | 1 |
| 5 | A | 3,20 | 5 | 1 |
| 6 | B | 1,00 | 6 | 1 |
| 7 | B | 1,00 | 7 | 1 |
| 8 | A | 2,90 | 8 | 2 |
| 9 | B | 1,00 | 9 | 1 |
| 10 | B | 1,00 | 9 | 2 |
| 11 | B | 1,00 | 10 | 2 |
| 12 | B | 1,00 | 11 | 2 |

# Data Processing Guidelines

- The proposed exercise introduces one sample strategy to process collected data and enrich the road network layer with missing indicators

3) The last step aims at computing summary statistics for each point *type* at each road
    - Using the point layer resulting from the spatial join, compute the statistics by means of the *Statistics by Categories* QGIS processing tool

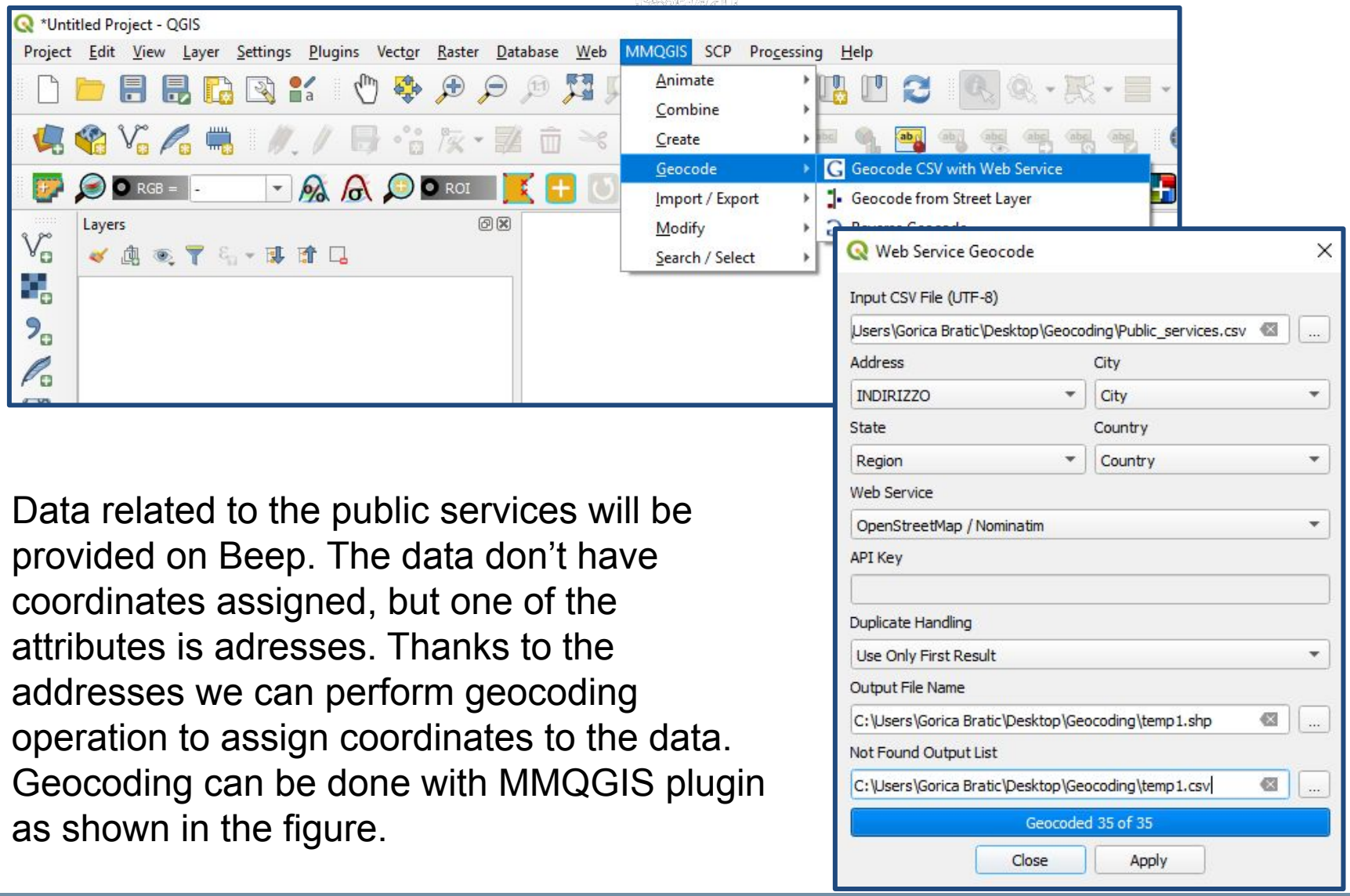



| | type | id_road | count | mean |
|---|---|---|---|---|
| 1 | B | 1 | 6 | 1 |
| 2 | A | 1 | 2 | 3.35 |
| 3 | B | 2 | 3 | 1 |
| 4 | A | 2 | 1 | 2.9 |
| 5 | A | 3 | 3 | 3.6 |
| 6 | B | 3 | 4 | 1 |
| 7 | B | 4 | 2 | 1 |
| 8 | A | 4 | 2 | 3.65 |
| 9 | B | 5 | 3 | 1 |
| 10 | A | 5 | 3 | 3.2 |

**In this example, considering e.g. point attribute *A = sidewalk width*, and *B = lightning*, we have obtained the mean sidewalk width and the count of lights for each road!**

**These indicators can be then used to enrich the roads layer that is the purpose of the lab data preprocessing!!**

# Data Processing Guidelines




Data related to the public services will be provided on Beep. The data don't have coordinates assigned, but one of the attributes is adresses. Thanks to the addresses we can perform geocoding operation to assign coordinates to the data. Geocoding can be done with MMQGIS plugin as shown in the figure.

# Guidelines for Website and Web GIS

- You can use a template for creating the website. Then you will need to edit the code of the template to customize it. Some websites that offer free templates are:
    - https://html5up.net/
    - https://templated.co/
    - https://bootstrapmade.com/

- You should use the technologies taught in practice lessons for building the Web GIS. You should store the geospatial data on GeoServer, retrieve them using OGC standards and visualize them with OpenLayers in a Web GIS. Your Web GIS should be on a local server.

- You can visualize the results of the calculations of original and enhanced PLoS by:
    - using a single colour palette for walkability for the two datasets,
    - enabling the query of streets for getting information regarding walkability, or
    - another method.

# Tutors' Contact Information

- Maria Antonia Brovelli: maria.brovelli@polimi.it
- Candan Eylül Kilsedar: candaneylul.kilsedar@polimi.it
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