

ISA

Geographic Information Systems 2026/2027

Lesson 07 - A diagrammatic language to represent one solution for a problem

Topics

- Diagrammatic representation of an analysis workflow
- Notation and syntax
- Example using Ex03

Analysis and reproducibility

Analysis – usually, several operations are needed to solve a problem with GIS

- The solution is composed by an ordered sequence of operations, each one involving at least one geographic data set (often more than one)
- the adopted sequence of operations is often called the process of a solution

Reproducibility – different users will achieve the same result, under the same circumstances – **data** and **algorithms**

- It is crucial to document this process in detail and completely in order to be able to:
 - validate the solution (or to find errors in the process that do not allow to validate the solution)
 - to communicate the process to others
 - to re-use it when required
 - to use it as the description (or memory) of the solution

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Analysis and reproducibility

Documenting the **analysis** (process of a solution) to guarantee **reproducibility** can be achieved using:

- a given natural language
- a diagrammatic language
 - more synthetic
 - easier to readers

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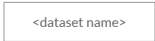
Solution design

- Problem solving **must start with the design of the process** that will be used to reach the solution
 - **conceptual design**
- Often a problem has more than one solution; it is important to choose the **best process to increase GIS efficiency**
- When comparing processes with equivalent results, the one with **the lowest cost** is considered to be the best process
 - costs in GIS: data collection, human resources, computational (time, memory, ...), ...
- During the conceptual phase it is possible to compare different solutions, to evaluate their costs and to choose the best process
 - **avoid wasting resources** by implementing worse processes and only recognize that better solutions exist when it is too late to be useful
- Only after the conceptual phase, it is possible to safely implement the chosen process

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Notation

The notation of a diagrammatic language suitable to represent solutions to GIS processes includes setting a few symbols:

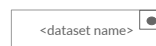
- Rectangle is used to represent a table 
- Rectangle with a smaller rectangle in the upper right corner is used to represent a geographic dataset (gds) 
- To represent a gds, the upper right rectangle includes a special signal depending on the structure type of this gds:



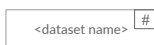
(vector) polygon



(vector) line



(vector) point

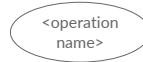


raster

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Notation

Oval figures represent operations:



Arrows will link data inputs to operations and operation to data outputs:

- may link one operation, that creates a virtual output to another operation (less often)
- may link input data to operation and again to the input data (generally dealing only with non-spatial attribute editing)



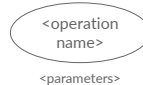
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Notation

- Under the gds/table rectangle indicate the relevant fields:
 - relevant for the operation
 - underline primary keys when relevant



- Under the operation oval figure indicate operation specifications

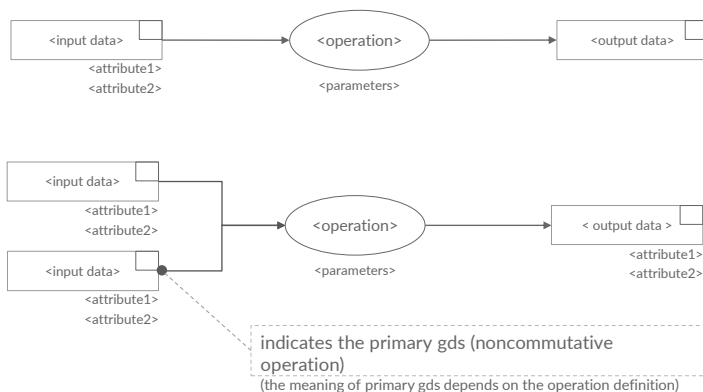


- In non-commutative operations a black dot marks the start of the arrow linked to the primary gds



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Notation – Examples



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Notation – Diagram rules

- Unnecessary attributes to reach the solution do not need to be represented
- The diagram should not show implementation details (dependent of the adopted GIS application)
- Ideally, a diagram should be independent of the GIS application used for the implementation
 - a solution is conceptual construction
- Every dataset is represented in a diagram only once
 - use connectors when necessary instead of dataset duplicated representations
- If more details are required to fully represent one solution, a (short) description in natural language can be added to the diagram
- After a first diagram designed to solve a problem, analyze it and optimize it (if possible) before implementing it (or before giving it to others)
 - avoid wasting your time and the time of others!
- During implementation, use the dataset names and attribute names as they are in the diagram

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Exercise

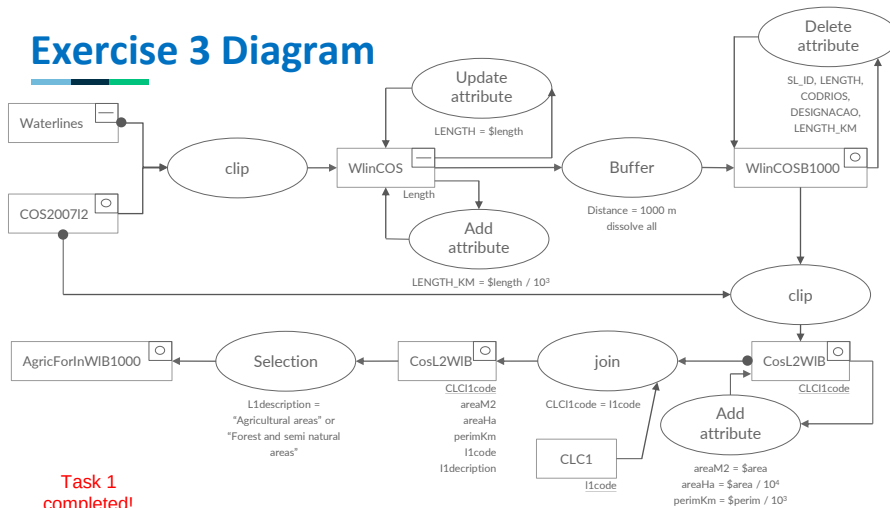
Look at exercise 3 and build the diagrammatic representation of the solution to achieve the goals established.

You may use:

- powerpoint
- diagrams.net
- miro.com

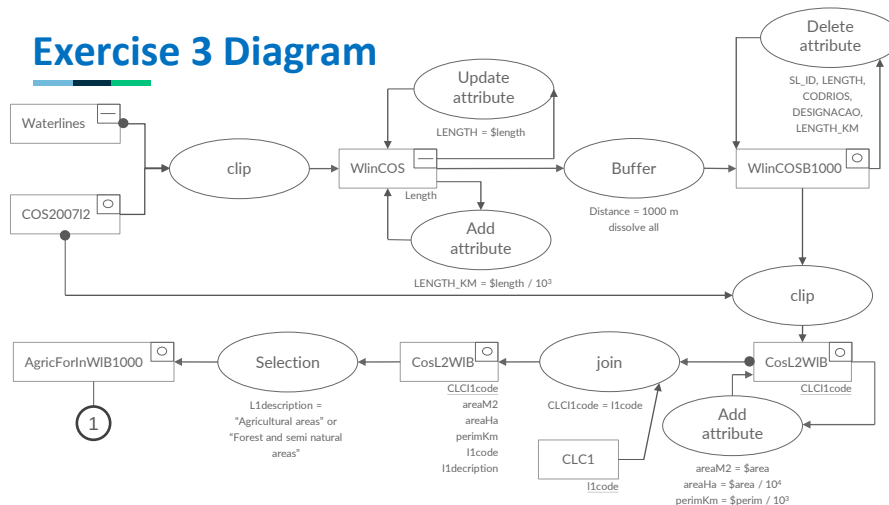
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Exercise 3 Diagram

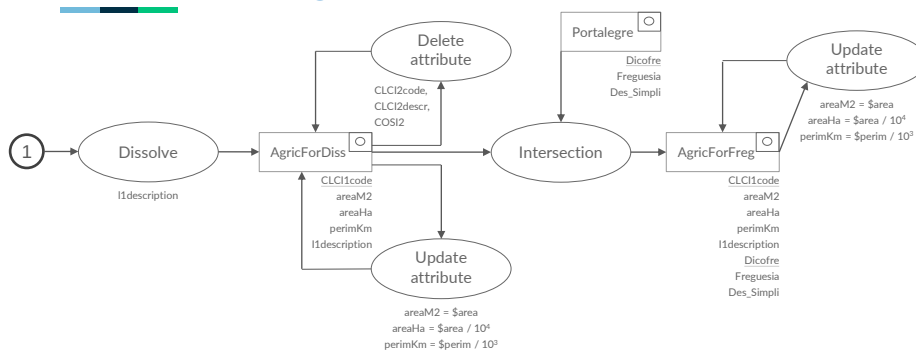


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Exercise 3 Diagram



Exercise 3 Diagram



Task 2b
completed!

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Credits



The structure and content of the course, including most of the slides and exercises was developed by Professor Graça Abrantes (SIG 2021_2022) and Professor Rui Figueira (SIG 2023_2024)

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