Spatial Intelligence

Angela Schwering

ifgi
Institute for Geoinformatics
University of Münster

What I do

- intelligent representation and processing of spatial information

From the Cognitive Perspective

- How do humans *perceive* spatial information?
- How do humans *process* spatial information?

Enhancement in Geoinformatics

- How to support humans interacting with GI software?
- Spatial Qualitative Reasoning
- Common-Sense Reasoning (similarity & analogy)

What I do

... and how does it fit to our project ideas?

1. ***Enhancing GUIs:***
   How to support humans interacting with GI software?

   → develop an intuitive GUI for querying spatial information systems

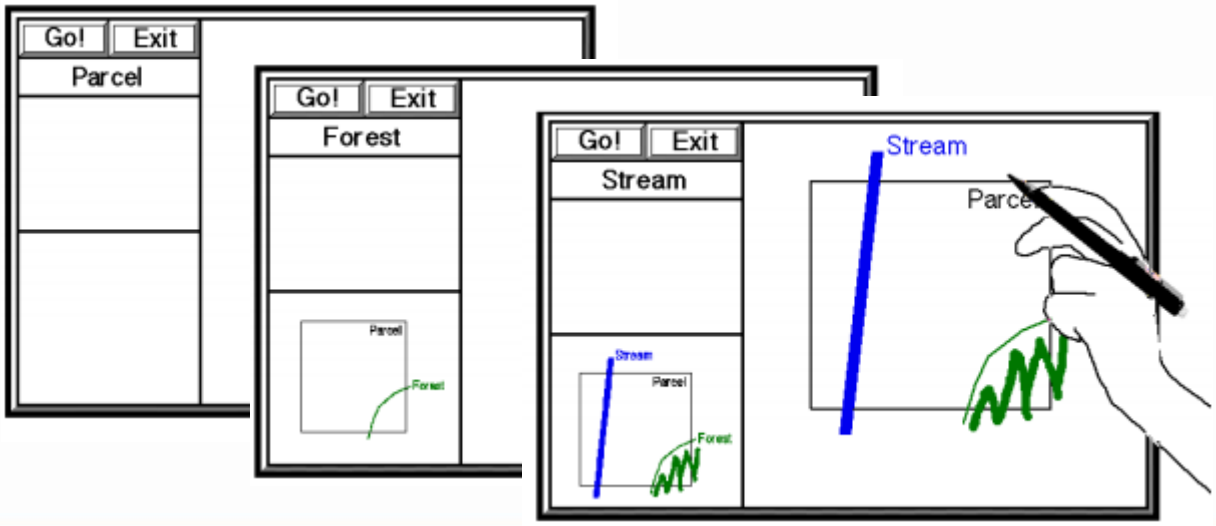
2. **Searching for Common Structures in Data**

   → use analogical comparison

Topic 1: Enhancing GUIs

Query-By-Sketch (M. Egenhofer)

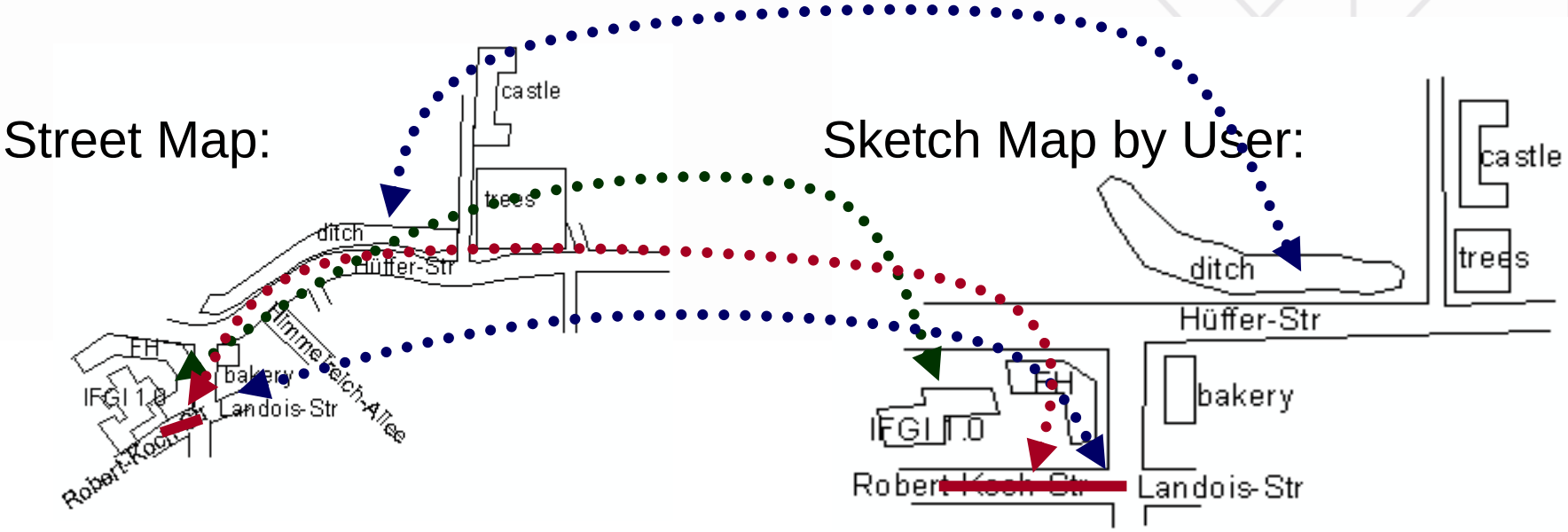
- make HCI easier
- describe query in formal way is not intuitive
- sketch maps support human spatial thinking



Topic 1: Enhancing GUIs

Typical imprecision / errors in human cognition:

- distance (importance, amount information)
- direction (rectangular angles, straighten)
- shape, size (simplify, distort)

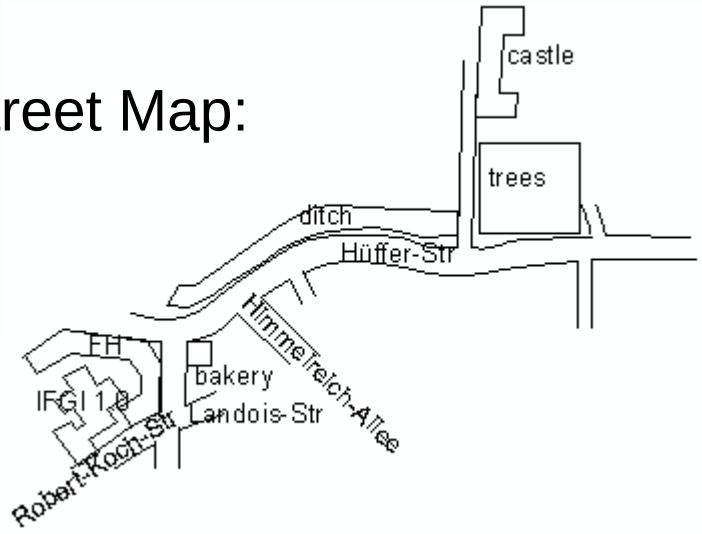


Topic 1: Enhancing GUIs

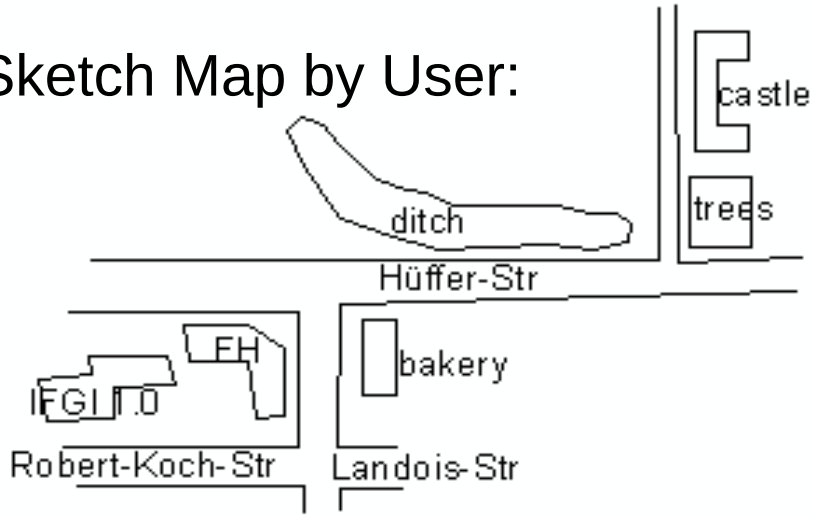
Typical imprecision / errors in human cognition:

- distance (importance, amount information)
- direction (rectangular angles, straighten)
- shape, size (simplify, distort)
- relevance

Street Map:



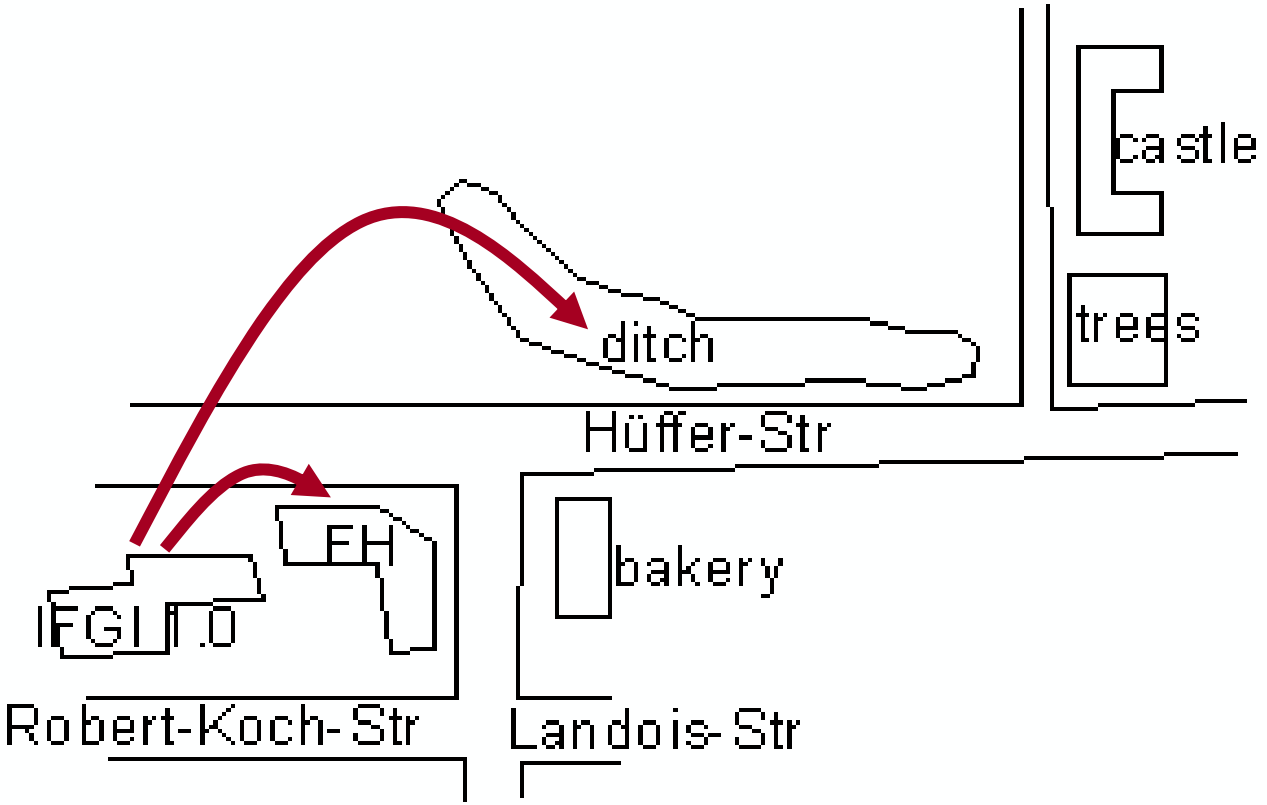
Sketch Map by User:



Topic 1: Enhancing GUIs

Formalization of sketches:

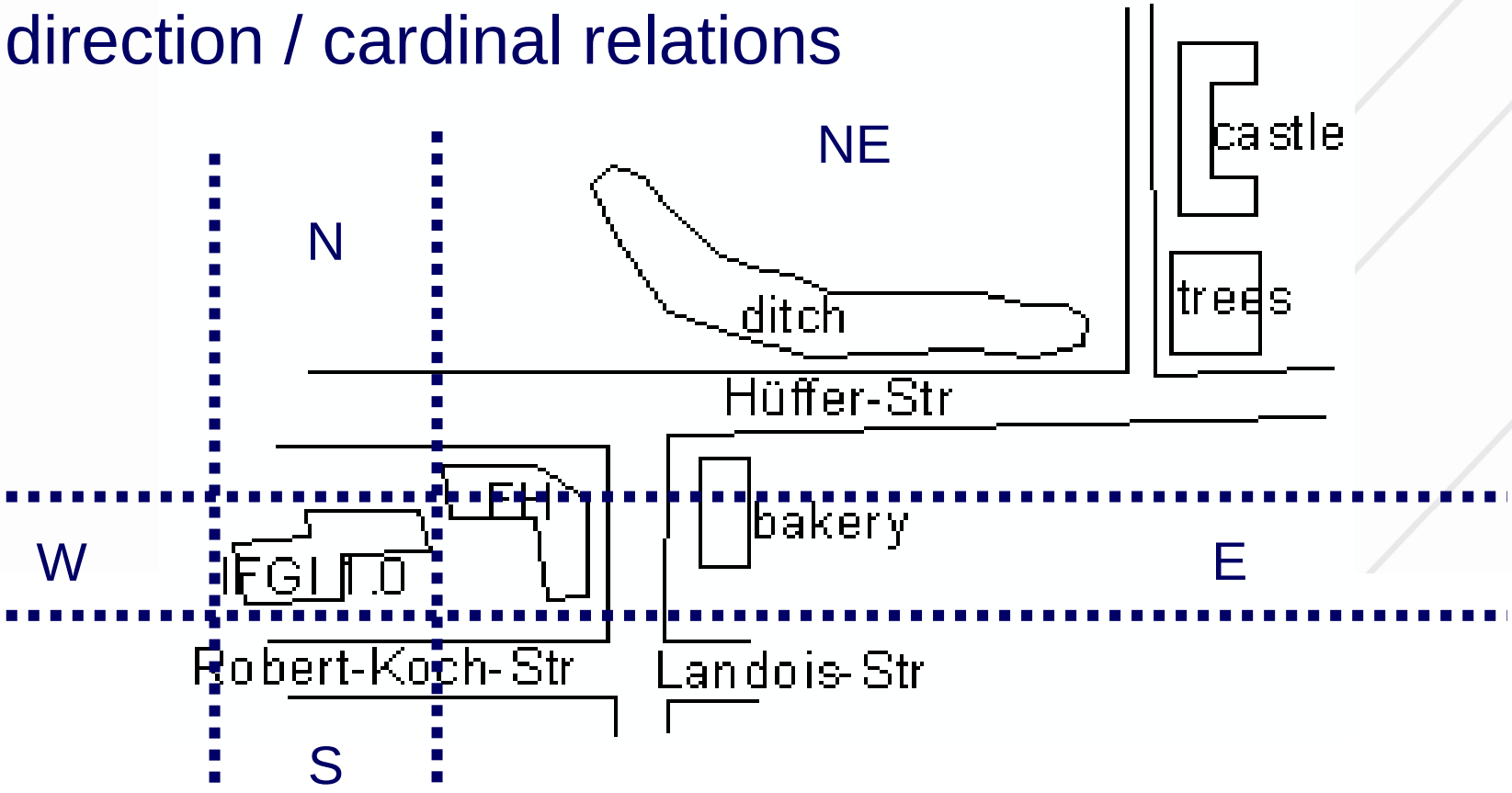
- topological relations



Topic 1: Enhancing GUIs

Formalization of sketches:

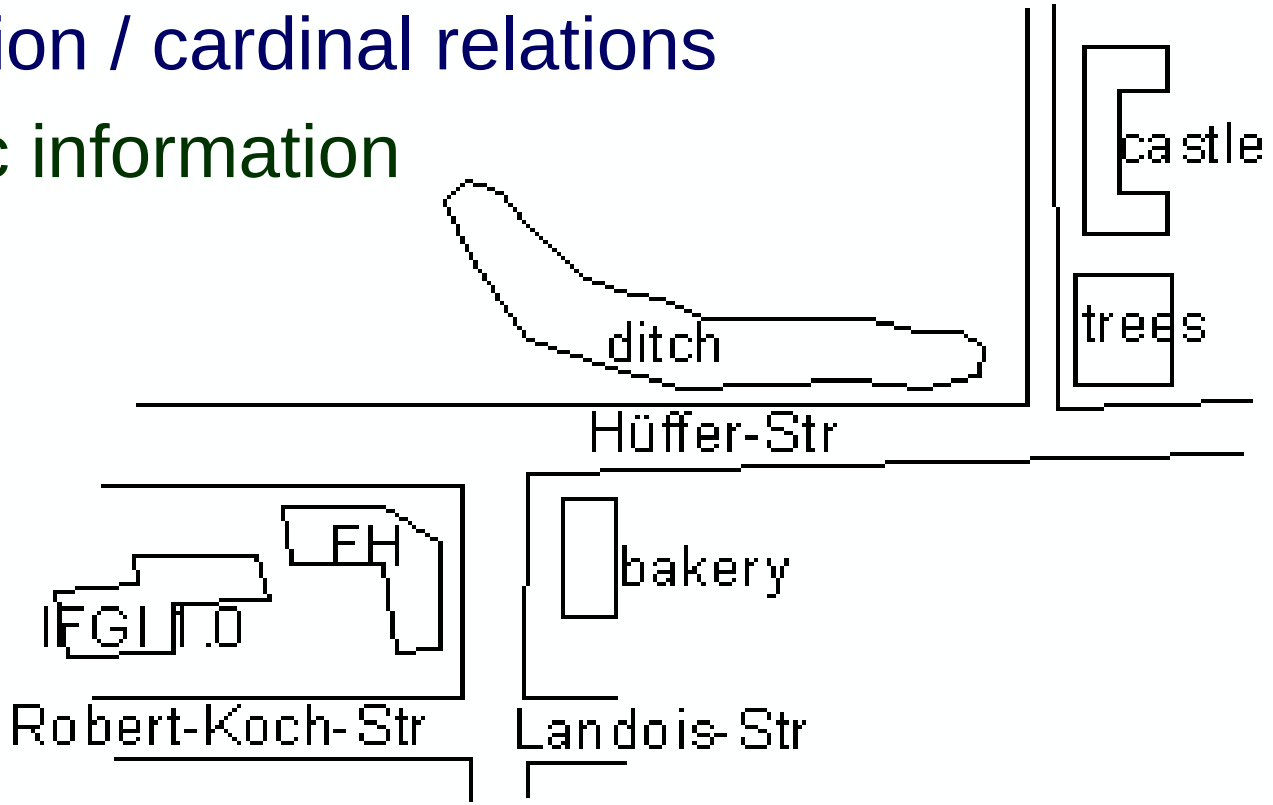
- topological relations
- direction / cardinal relations



Topic 1: Enhancing GUIs

Formalization of sketches:

- topological relations
- direction / cardinal relations
- metric information



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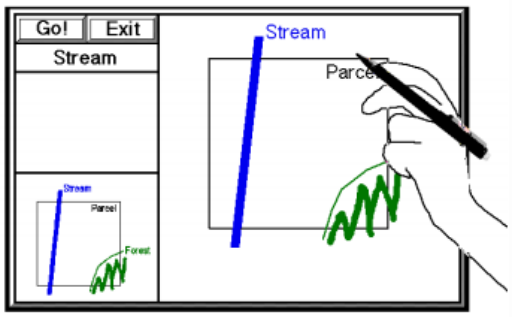

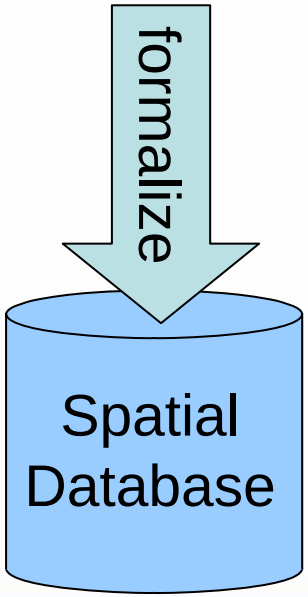

1. People draw sketches
   → analyze distortions / errors

2. Formalization of sketches
   → qualitative spatial relations?
   topology / metric / direction
   → what is important to capture?
   account for schematization errors in human cognition?

3. Test usability of the approach

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Topic 2: Searching Commonalities

Classical reasoning on computers

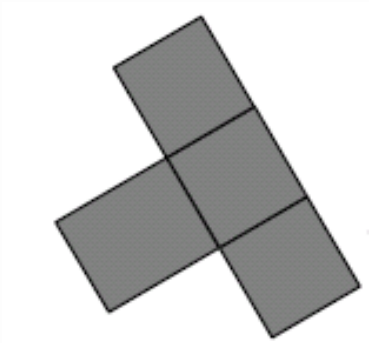
- deduction, abduction, induction

Human reasoning

- new situations are compared to previous similar experiences
- analogical reasoning
  - compare for structural similarities
  - map analogous elements
  - transfer knowledge from one situation to other situation

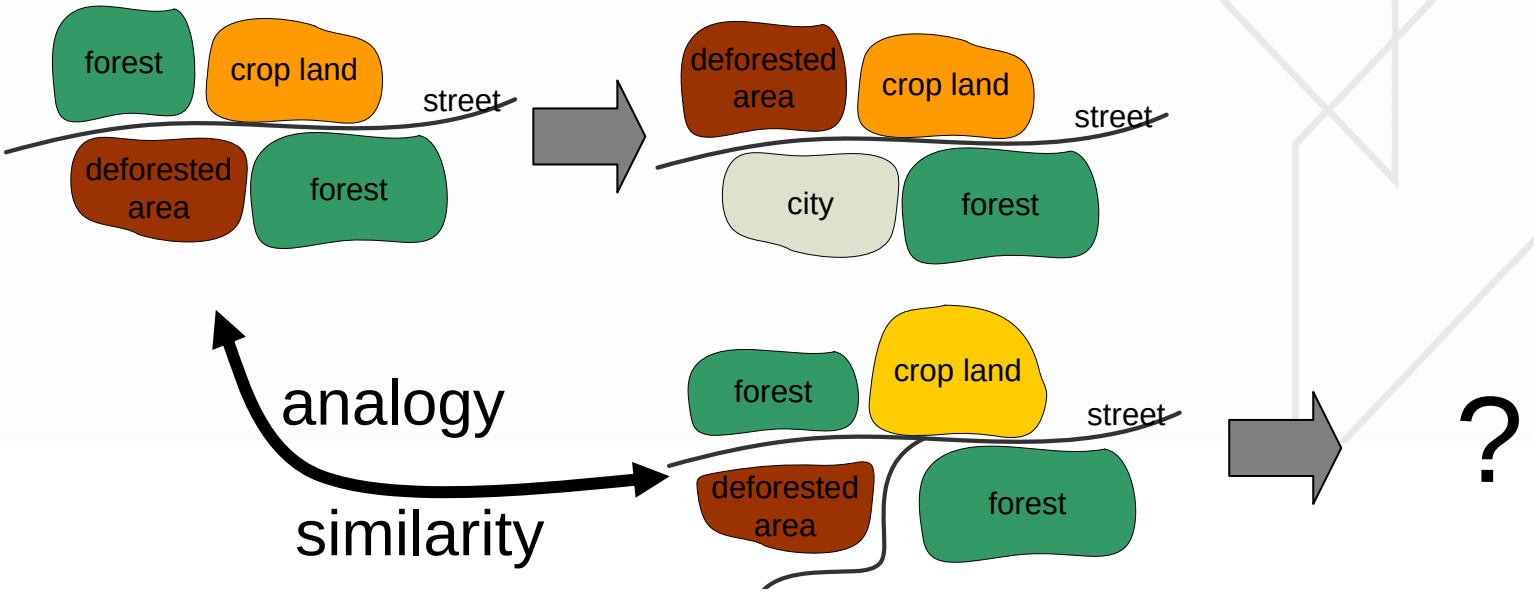
Topic 2: Searching Commonalities

- analogical reasoning used to automatically analyze topographic maps
  - classification of polygons (road layer)
  - spatial relation between polygons (adjacent)



Topic 2: Searching Commonalities

- changes lead to new developments
- learn from previous experiences
  - search for similar land use patterns
  - to predict development
  - to suggest best practices



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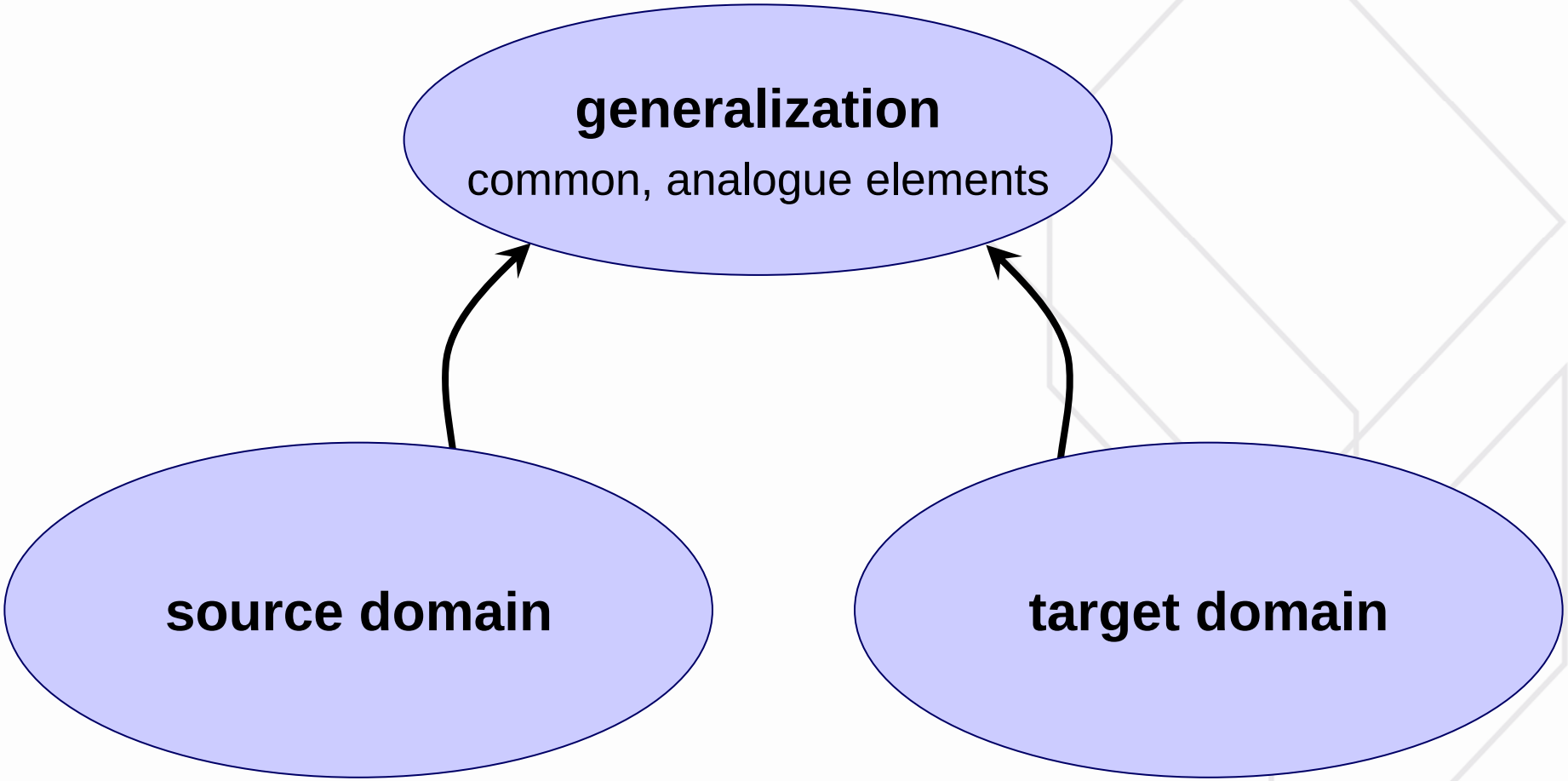

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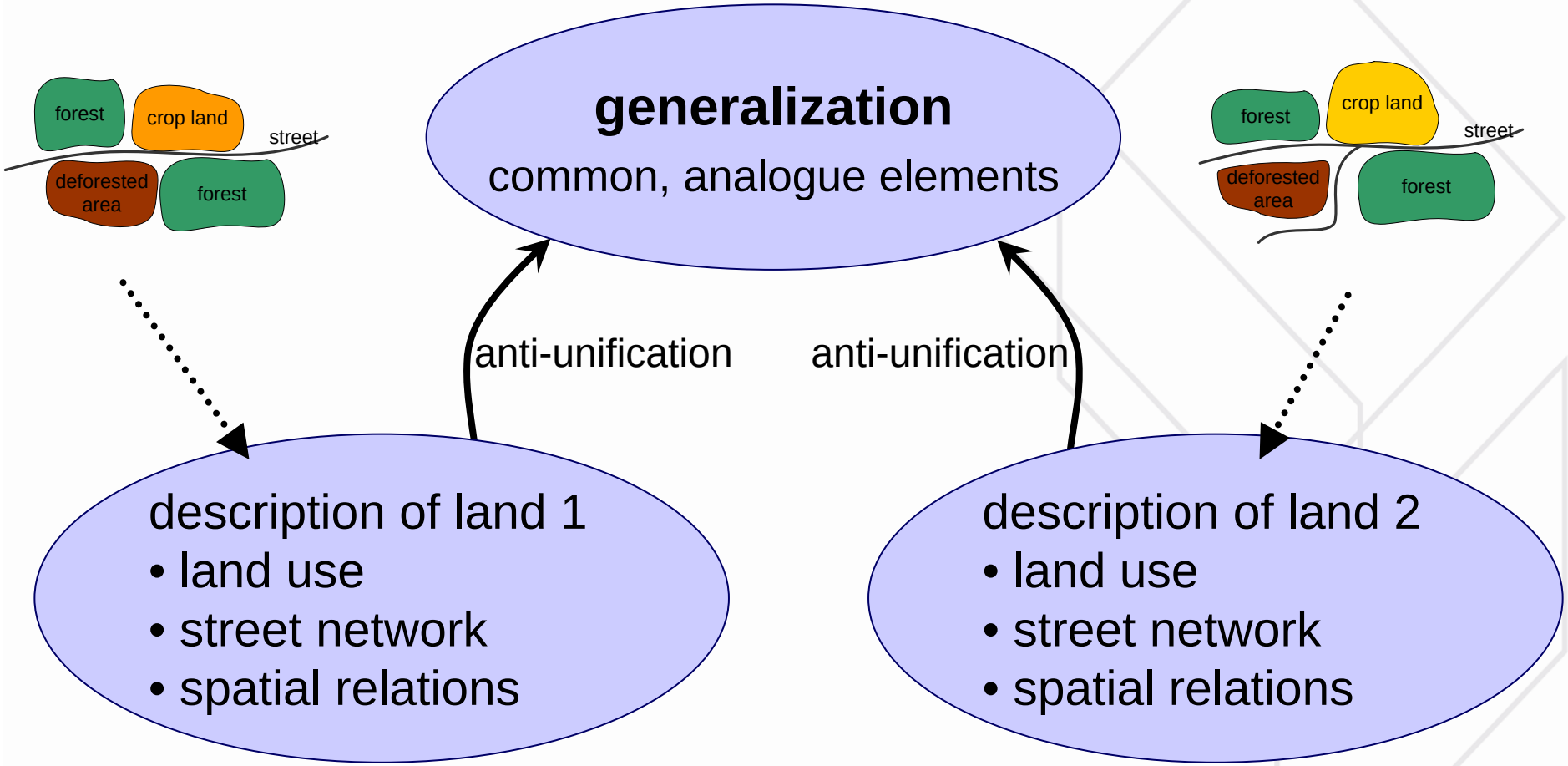
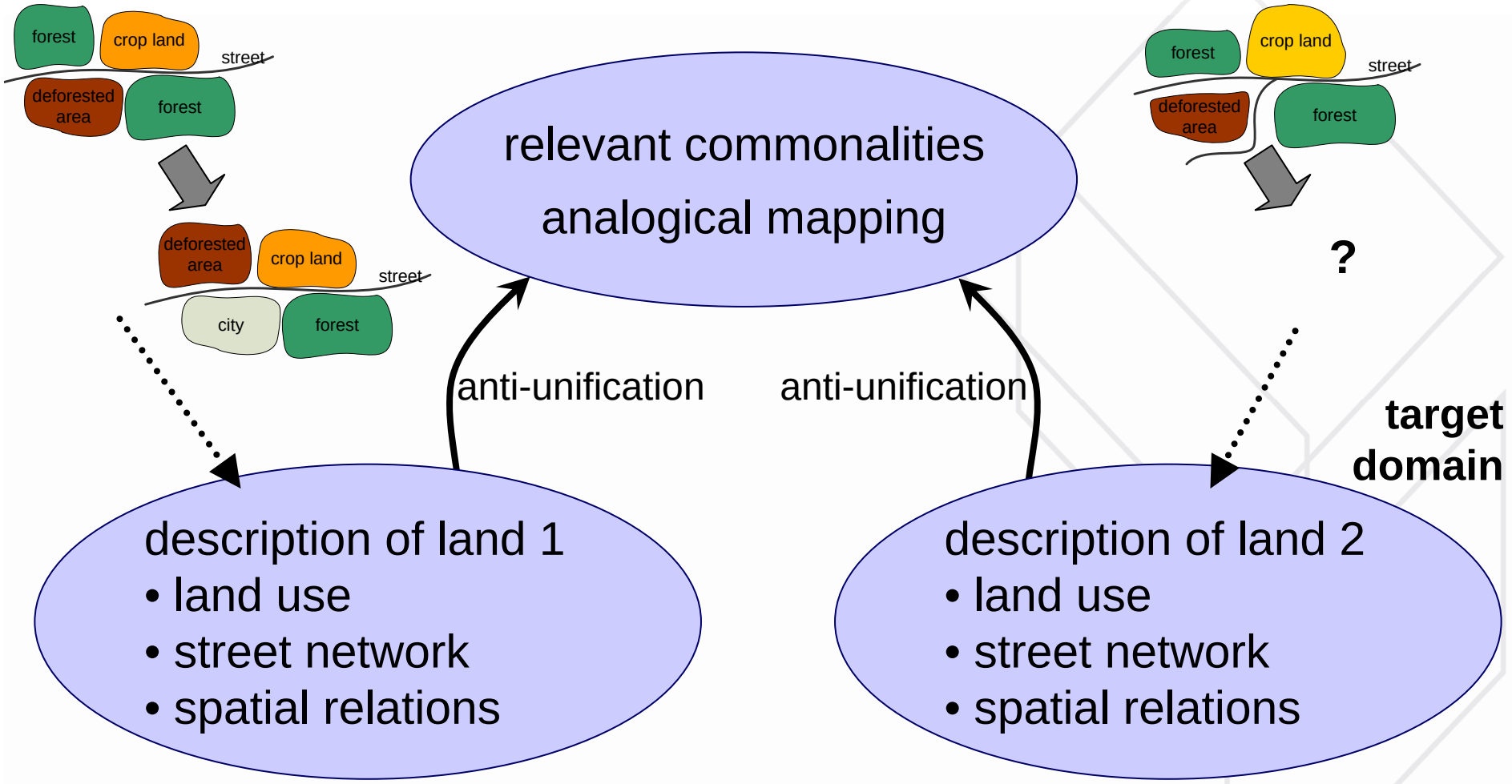


background knowledge

- knowledge about changes in land use patterns
- interrelations of different factors

Topic 2: Searching Commonalities



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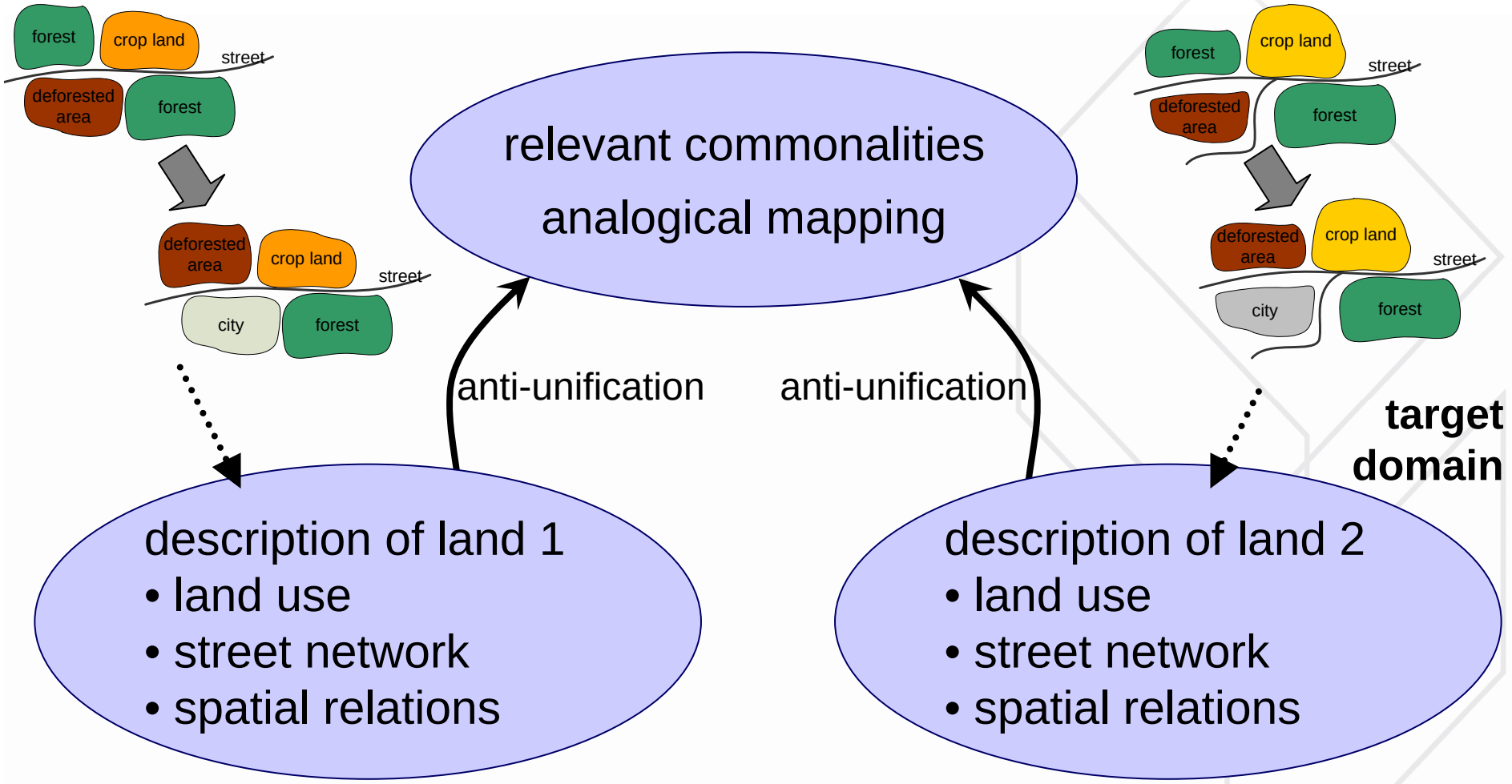

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Summary

- make interaction with systems easier for humans
- include human-level reasoning in information processing

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