

# Spatial Intelligence

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# What I do

## 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 databases

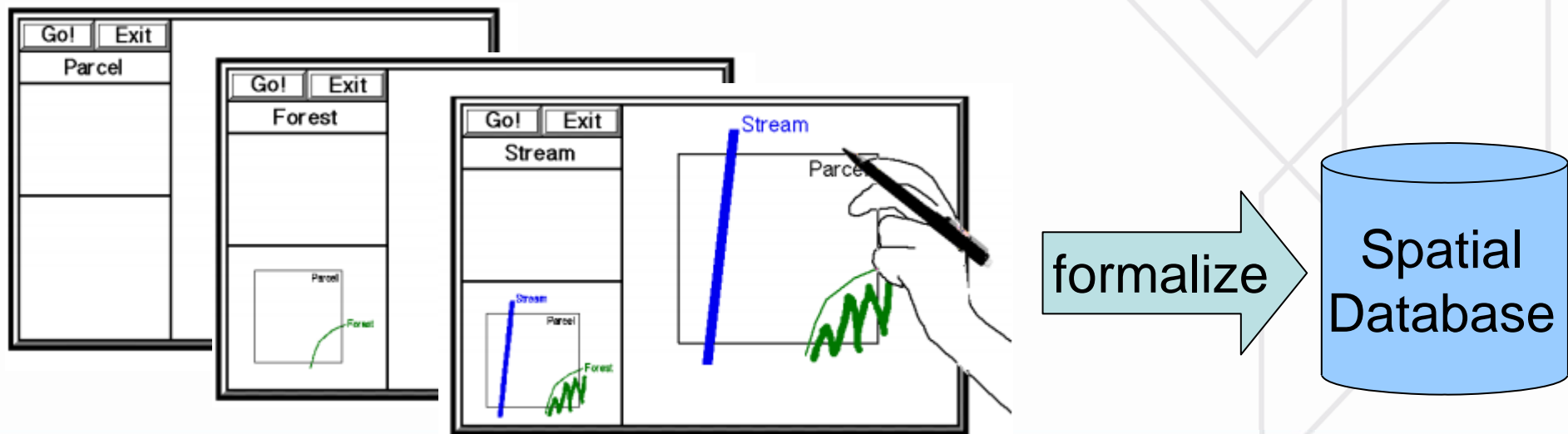
## 2. **Searching for Common Structures in Data**

→ use analogical comparison

# Topic 1: Enhancing GUIs

## Query-By-Sketch (M. Egenhofer)

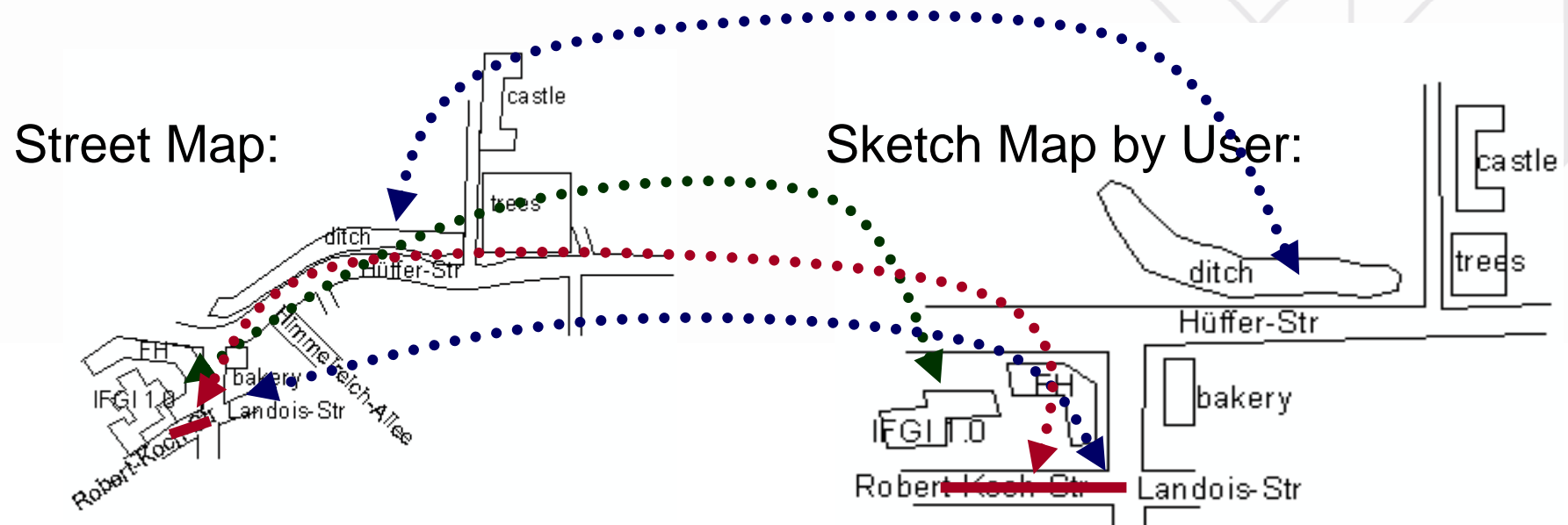
- make HCI easier
- describe query in formal way is not intuitive
- sketch maps support human spatial thinking



# Topic 1: Enhancing GUIs

Typical imprecision / errors in human cognition:

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

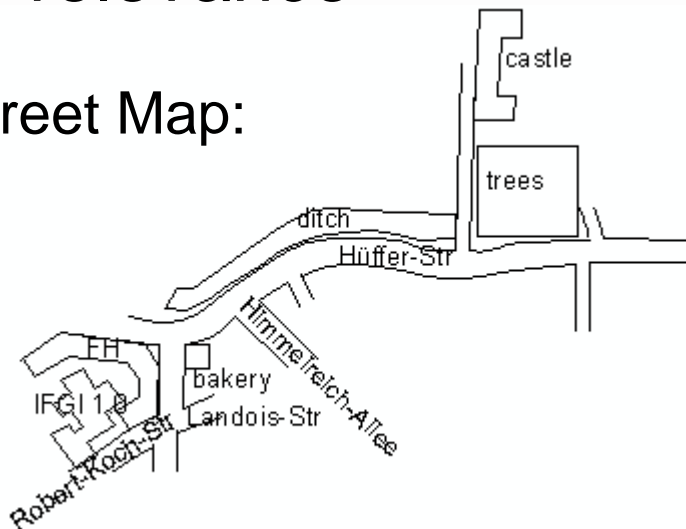


# Topic 1: Enhancing GUIs

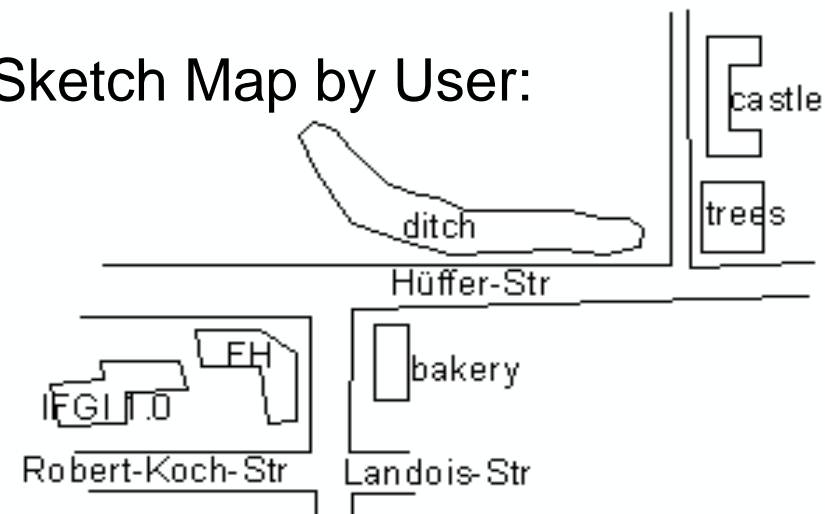
Typical imprecision / errors in human cognition:

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

Street Map:



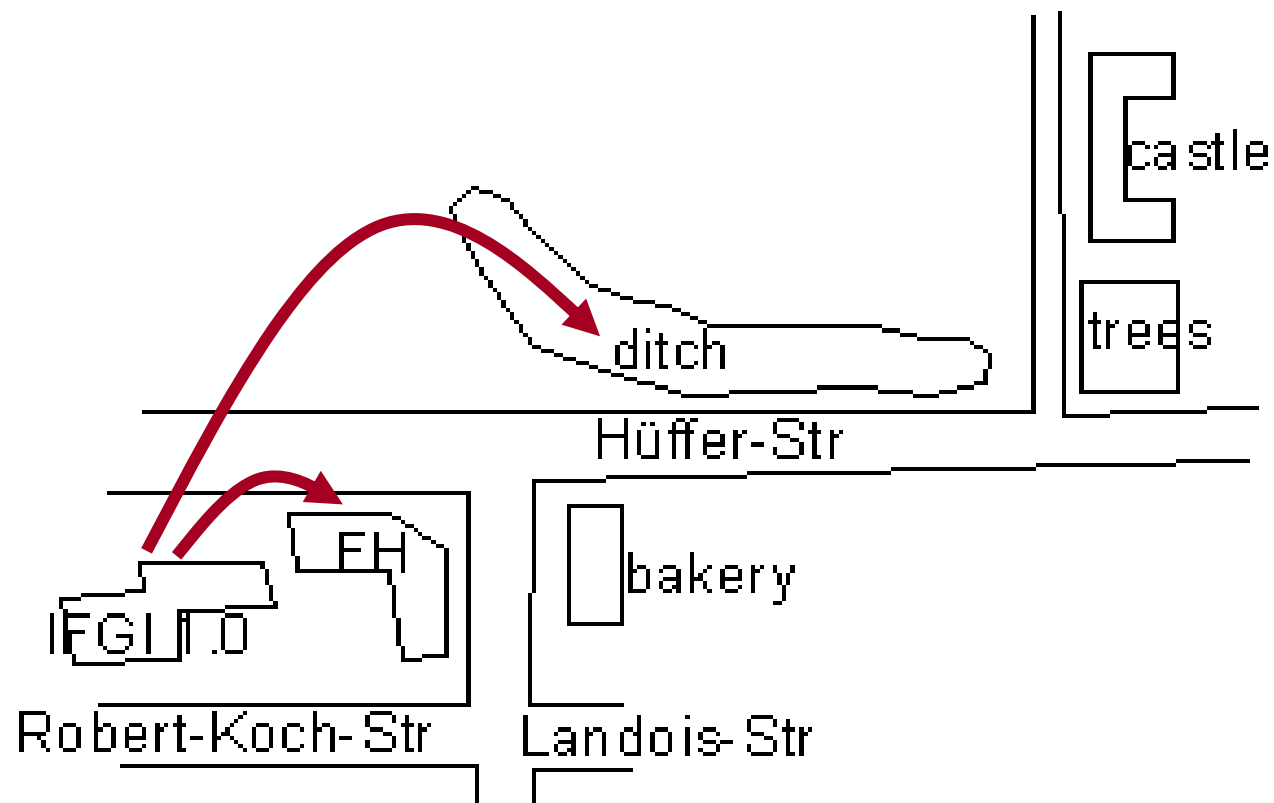
Sketch Map by User:



# Topic 1: Enhancing GUIs

Formalization of sketches:

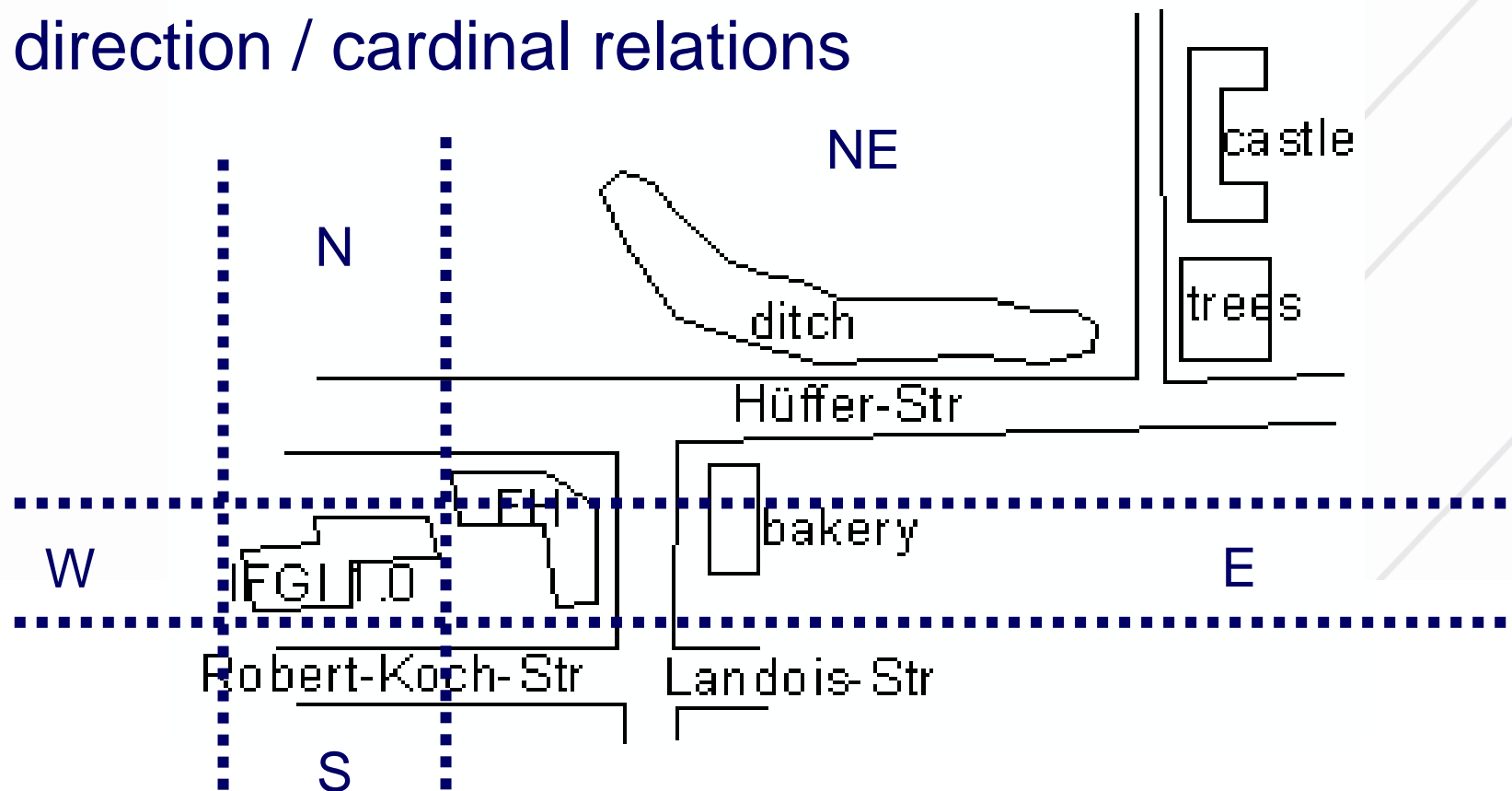
- topological relations



# Topic 1: Enhancing GUIs

Formalization of sketches:

- topological relations
- direction / cardinal relations

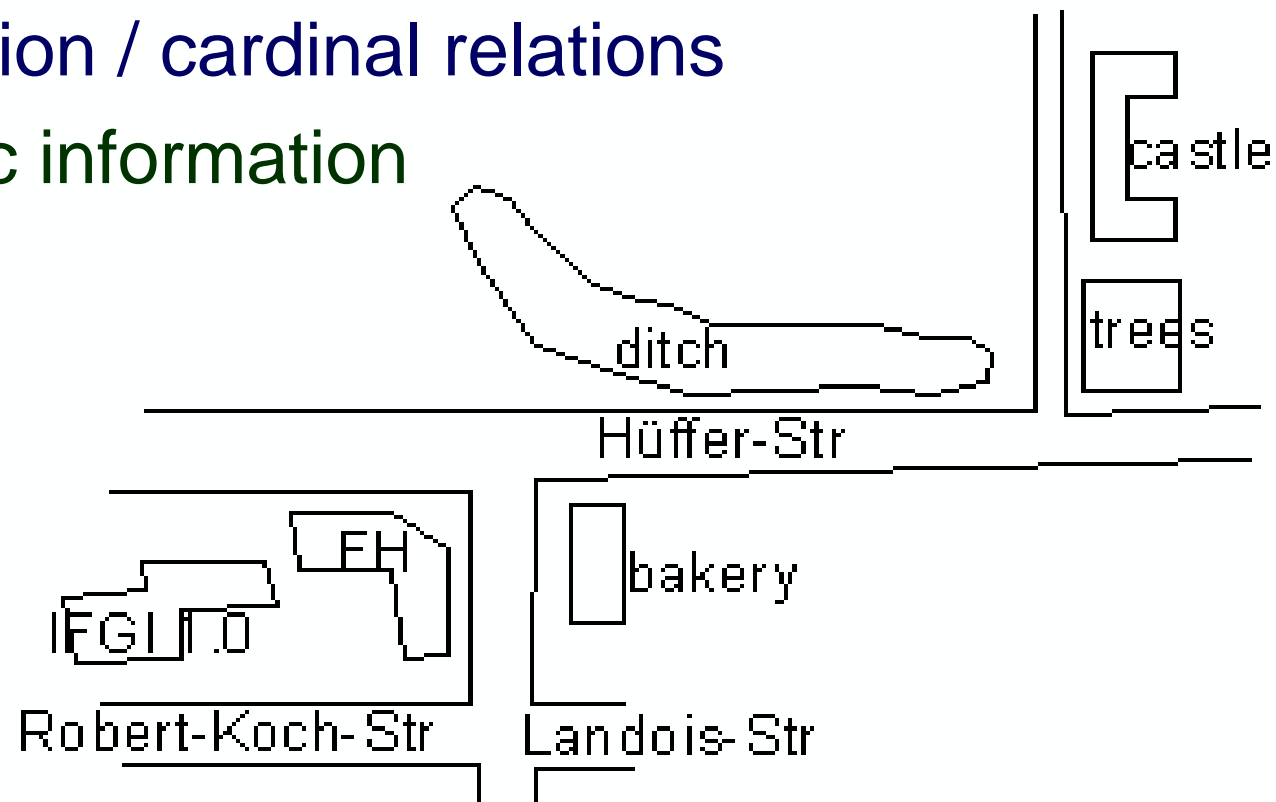




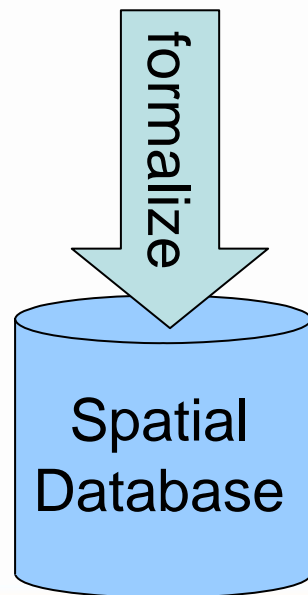
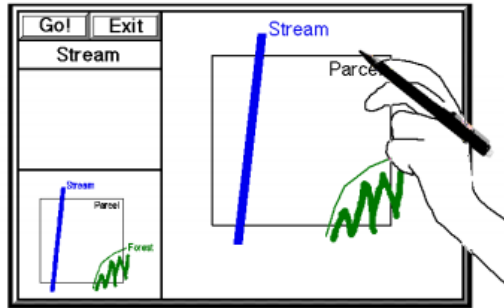
# Topic 1: Enhancing GUIs

Formalization of sketches:

- topological relations
- direction / cardinal relations
- metric information



# Topic 1: Enhancing GUIs



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

## 1. *Enhancing GUIs:*

How to support humans interacting with GI software?

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

→ use analogical comparison

# Topic 2: Searching Commonalities



## Classical reasoning on computers

- deduction, abduction, induction

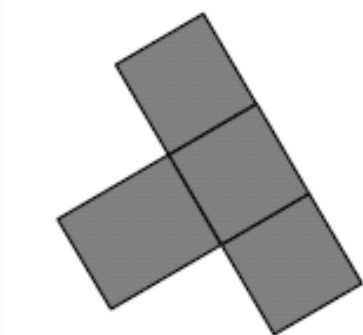


## Human reasoning

- 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

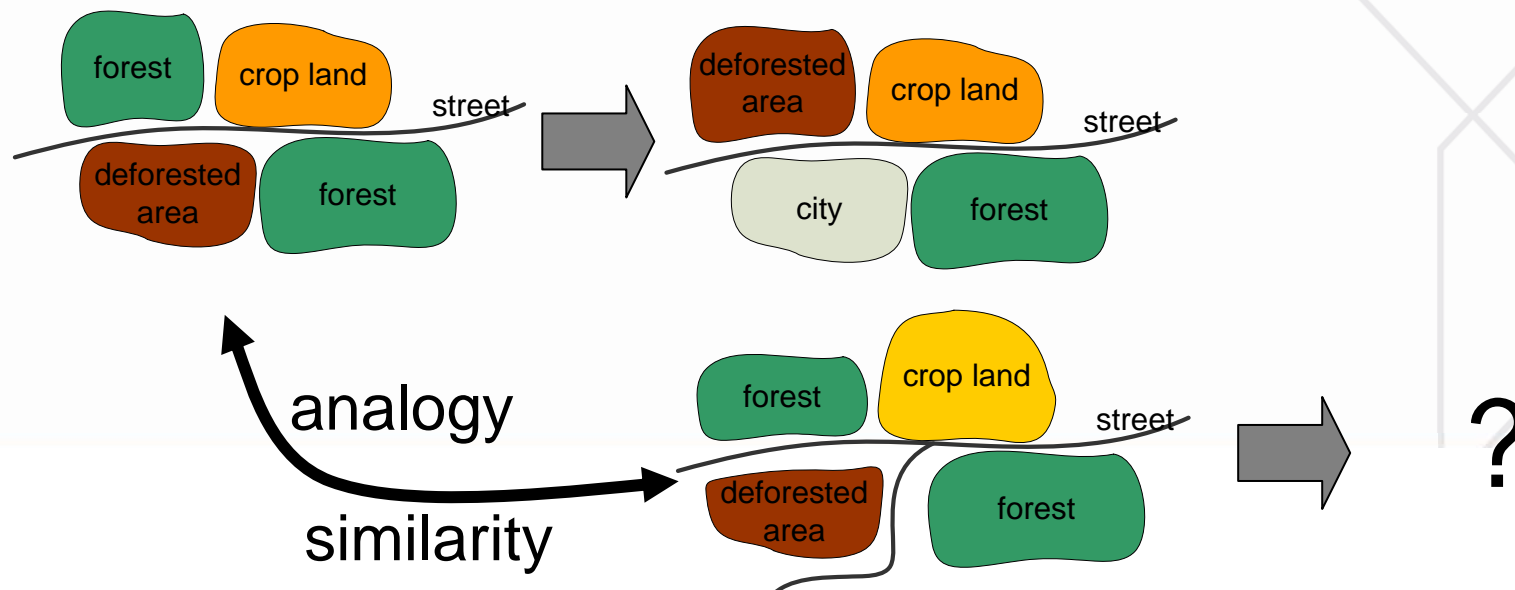
## Topic 2: Searching Commonalities

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

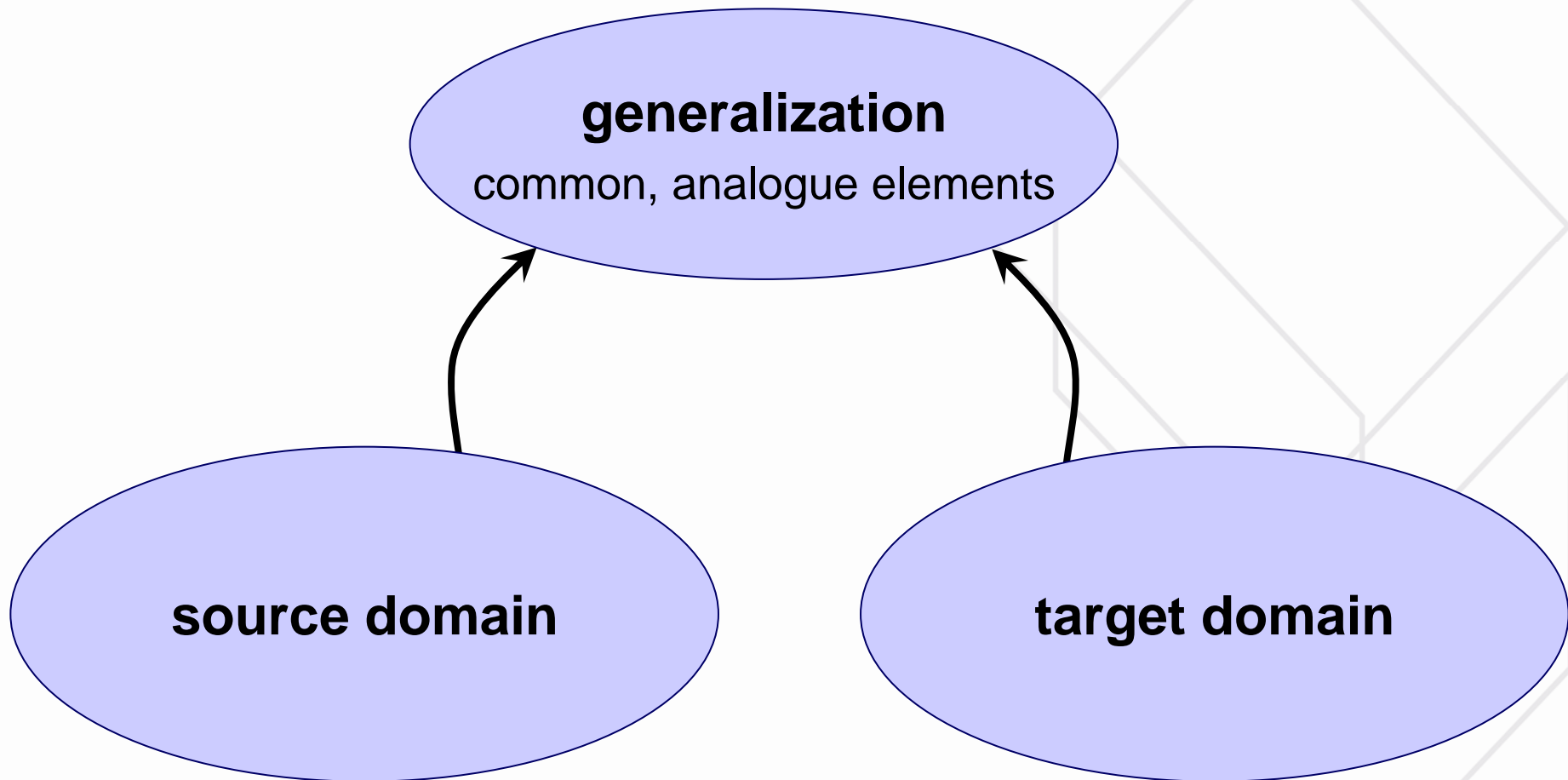


## Topic 2: Searching Commonalities

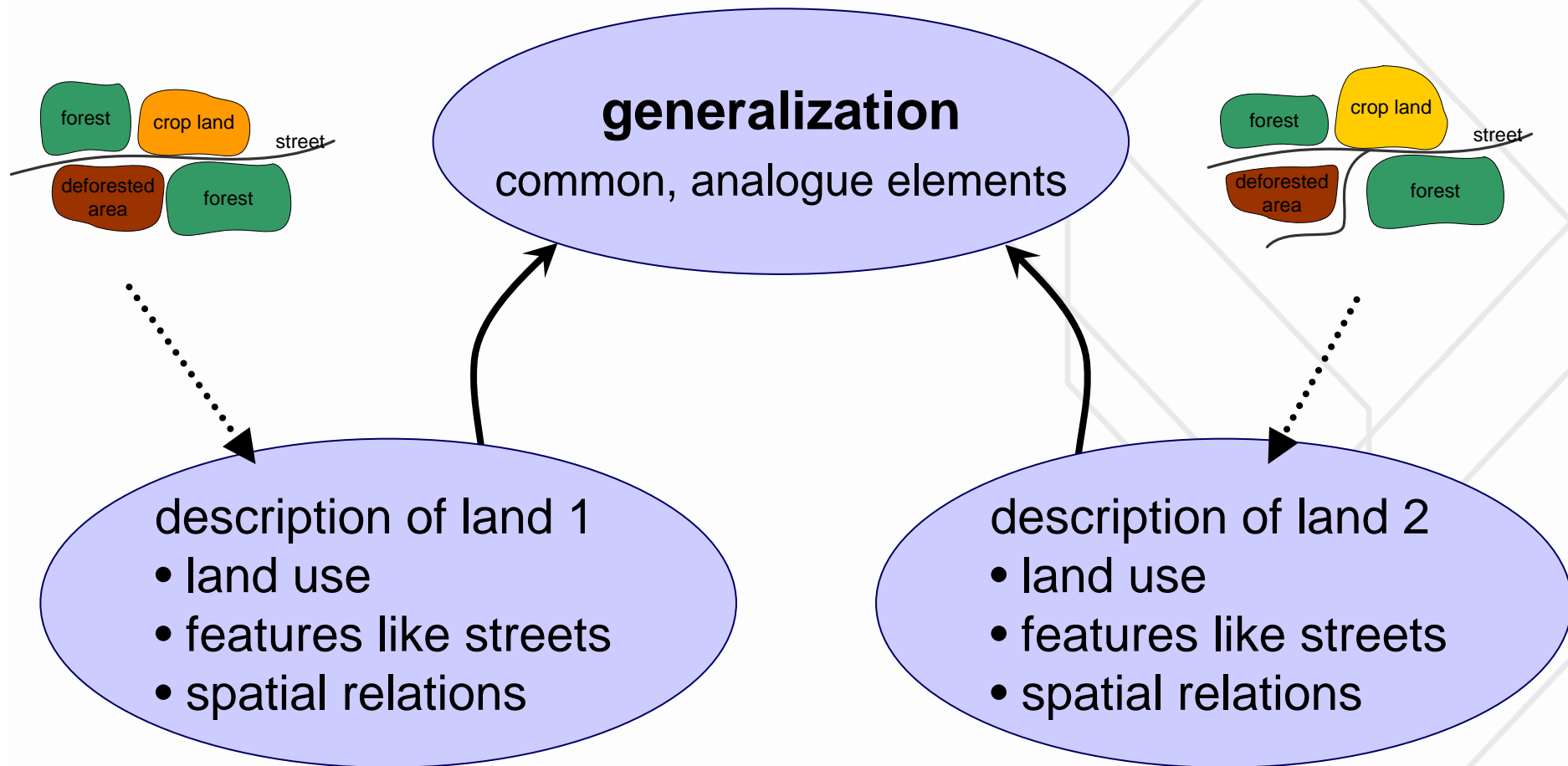
- changes lead to new developments
- learn from previous experiences
  - search for similar situations / places
  - to predict development
  - to suggest best practices



# Topic 2: Searching Commonalities

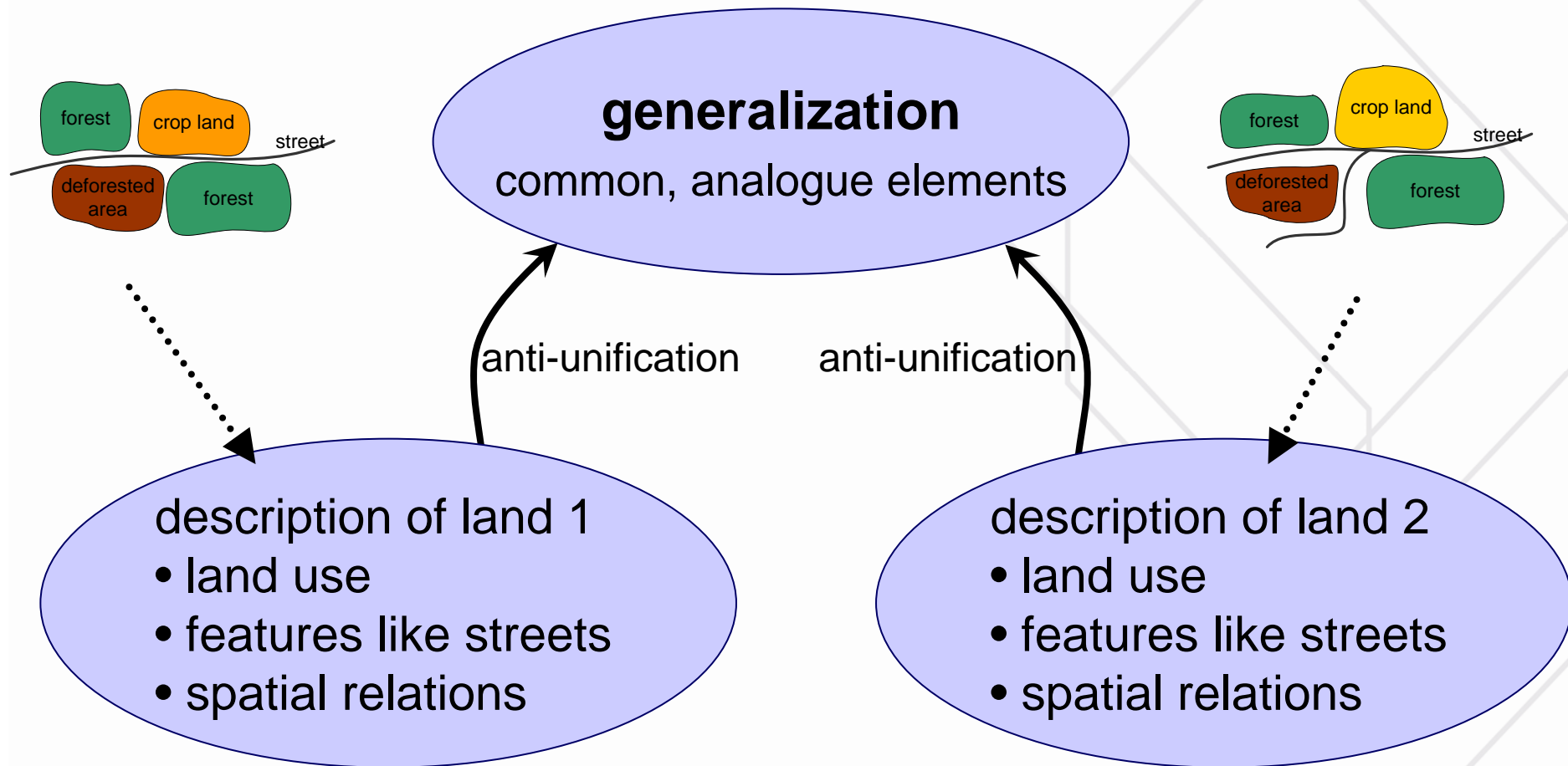


# Topic 2: Searching Commonalities





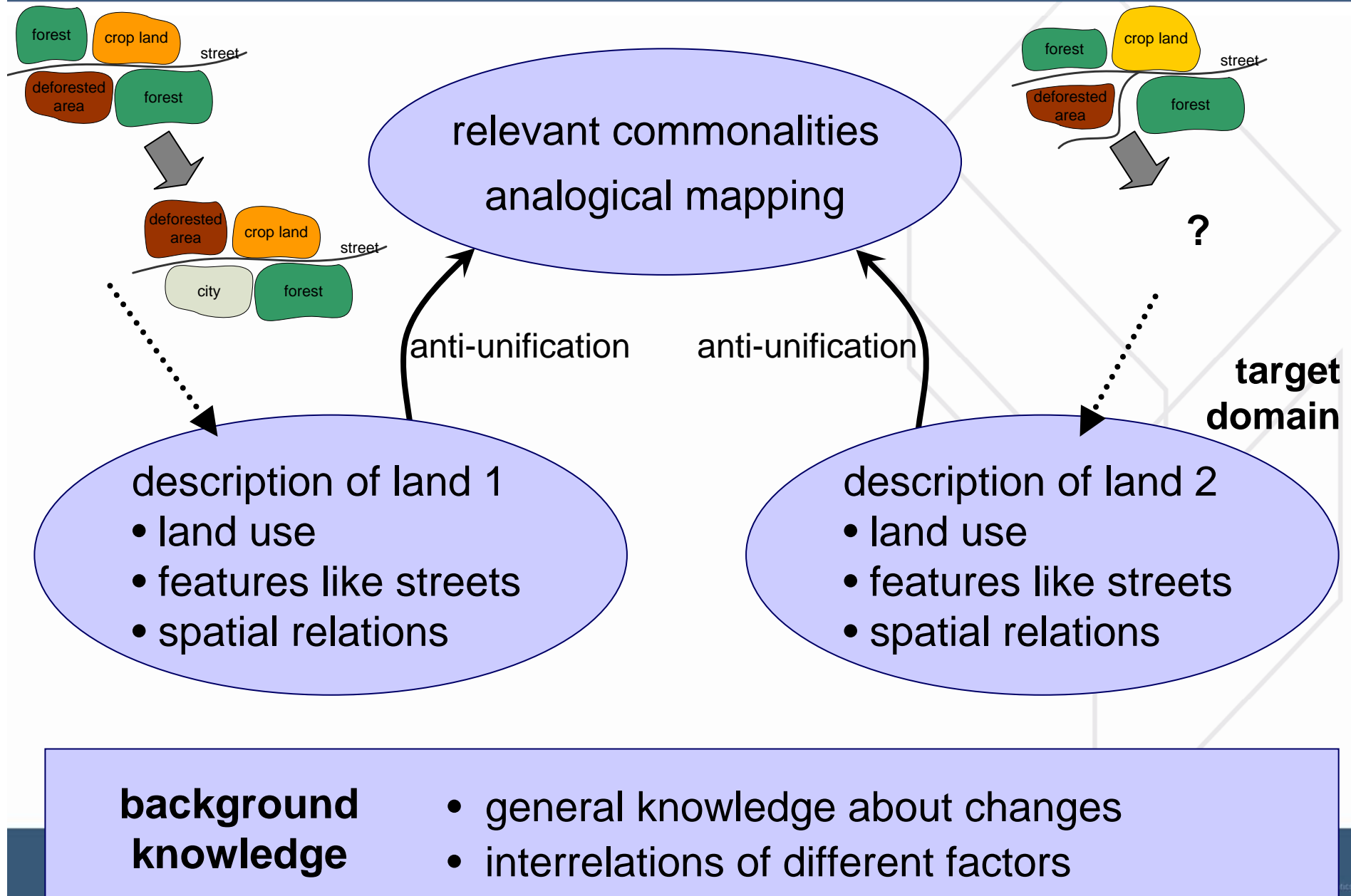
# Topic 2: Searching Commonalities



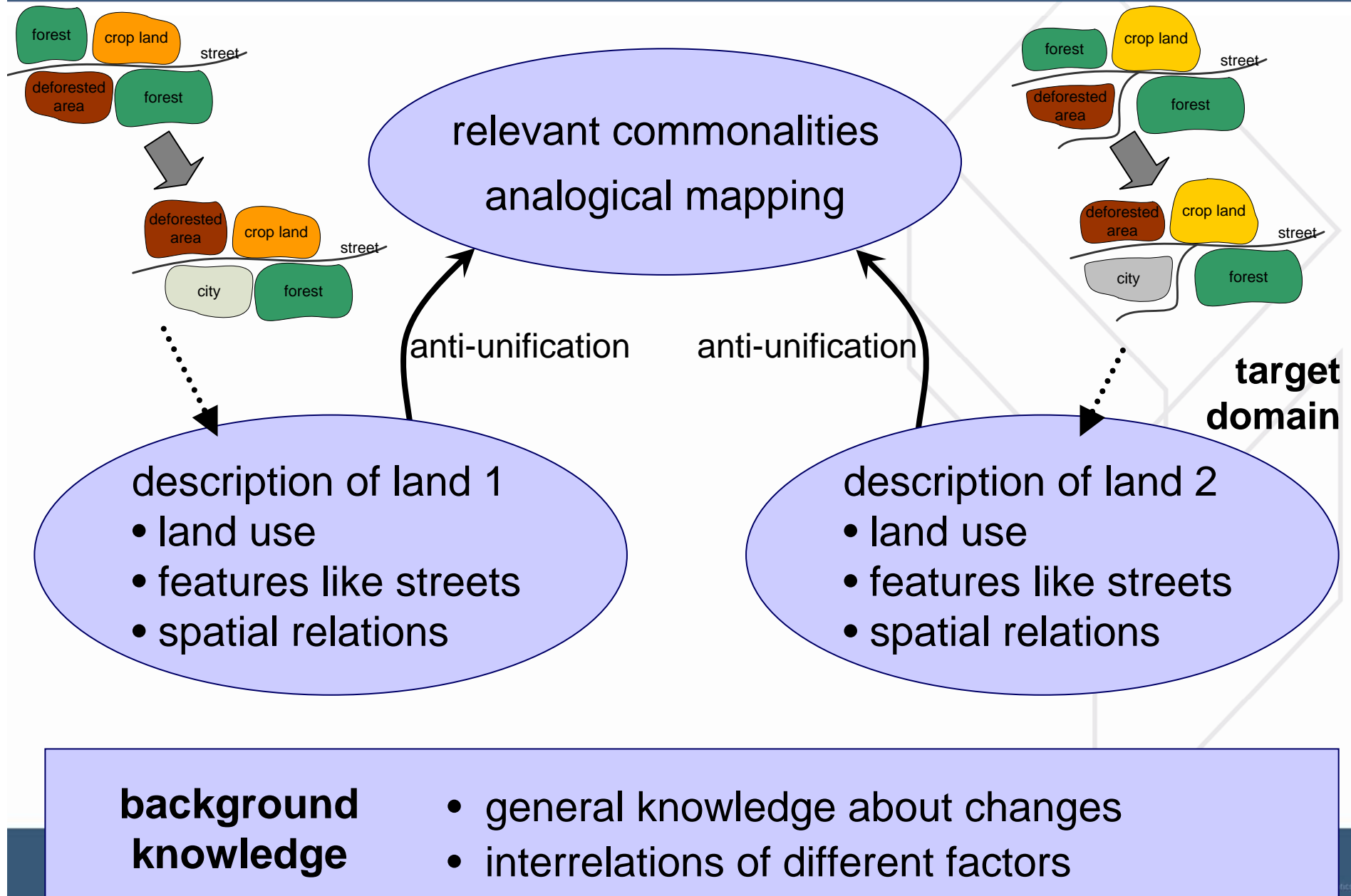
## background knowledge

- general knowledge about changes
- interrelations of different factors

# Topic 2: Searching Commonalities



# Topic 2: Searching Commonalities



# Summary

- make interaction with systems easier for humans
  - include human-level reasoning in information processing
- 1. *Enhancing GUIs:***  
How to support humans interacting with GI software?  
→ develop an intuitive GUI for querying spatial databases
  - 2. *Searching for Common Structures in Data***  
→ use analogical comparison