Leveraging Semantic Web Technologies for Geo-Database Interoperability

The LoBsteR project

GeoWeb 2008

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There is no Geographic Web!

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Case Study: Trip Planning

- Travel by plane, train, rent a car, drive your own?
- Book a hotel near the sights, not too expensive, suitable for kids or a business meeting?
- This should take half an hour
- Right now, it takes half a day

Challenge: lots of unstructured data

- Public transport routes, timetables, prices
- Sights location
- Hotel amenities and vacancies

Decision data is not available

- Difficult for data providers to expose their data in machine-readable form
- Difficult for a single site to aggregate all that data

Standards?

- We have lots of standards for physical and logical structure
- Standardizing semantics is a lot more difficult

Case Study: Cartographic formats

- Cartographic vector data in various formats
- How much work is needed to make data stored in one format available in any other format?

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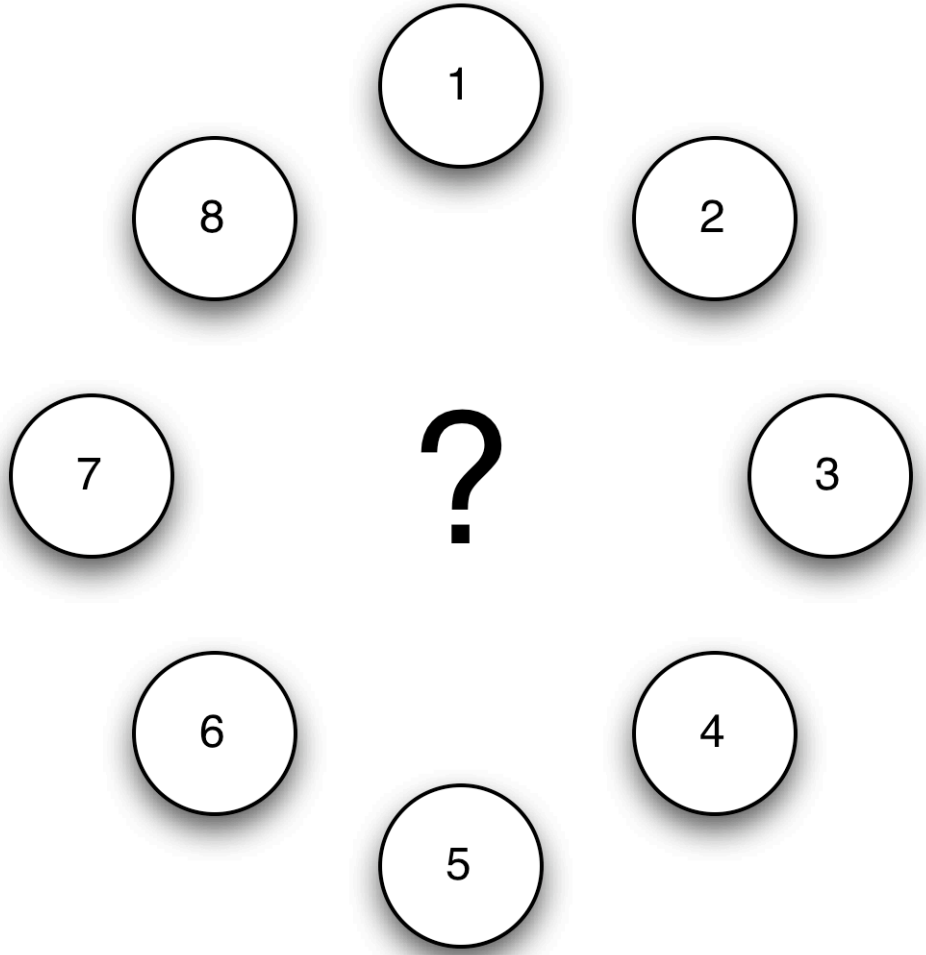
Case Study: Cartographic formats



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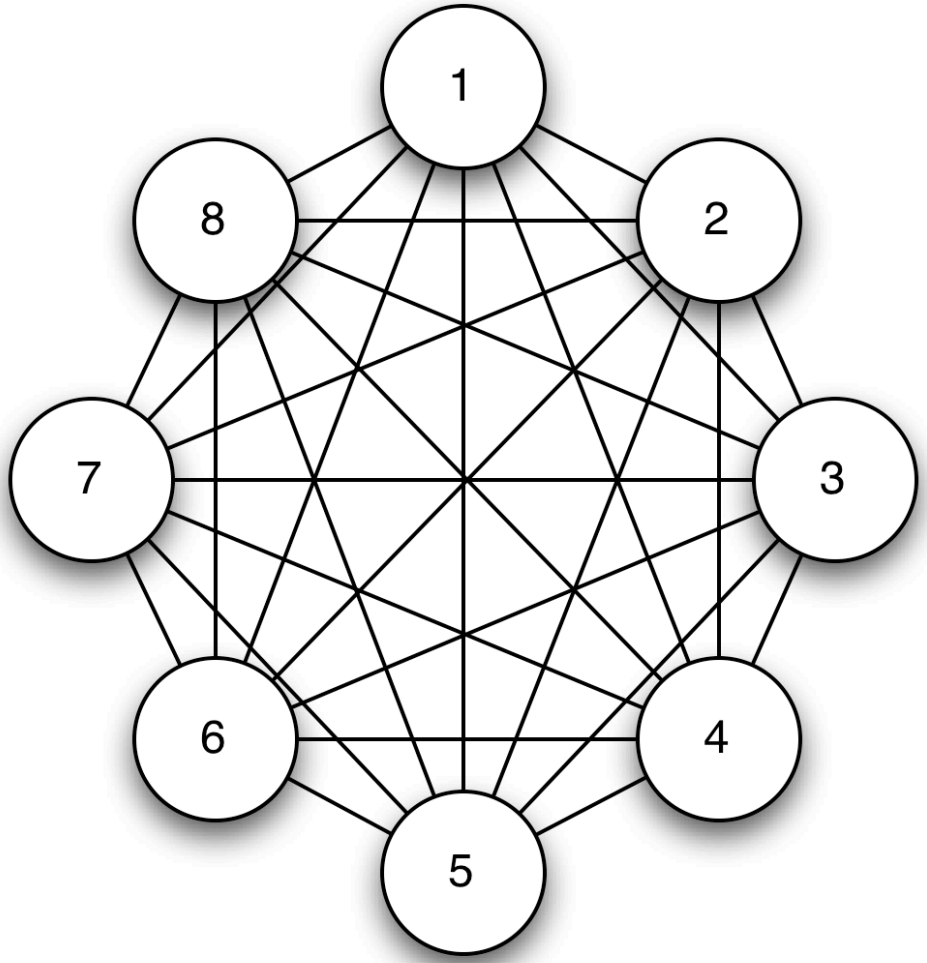

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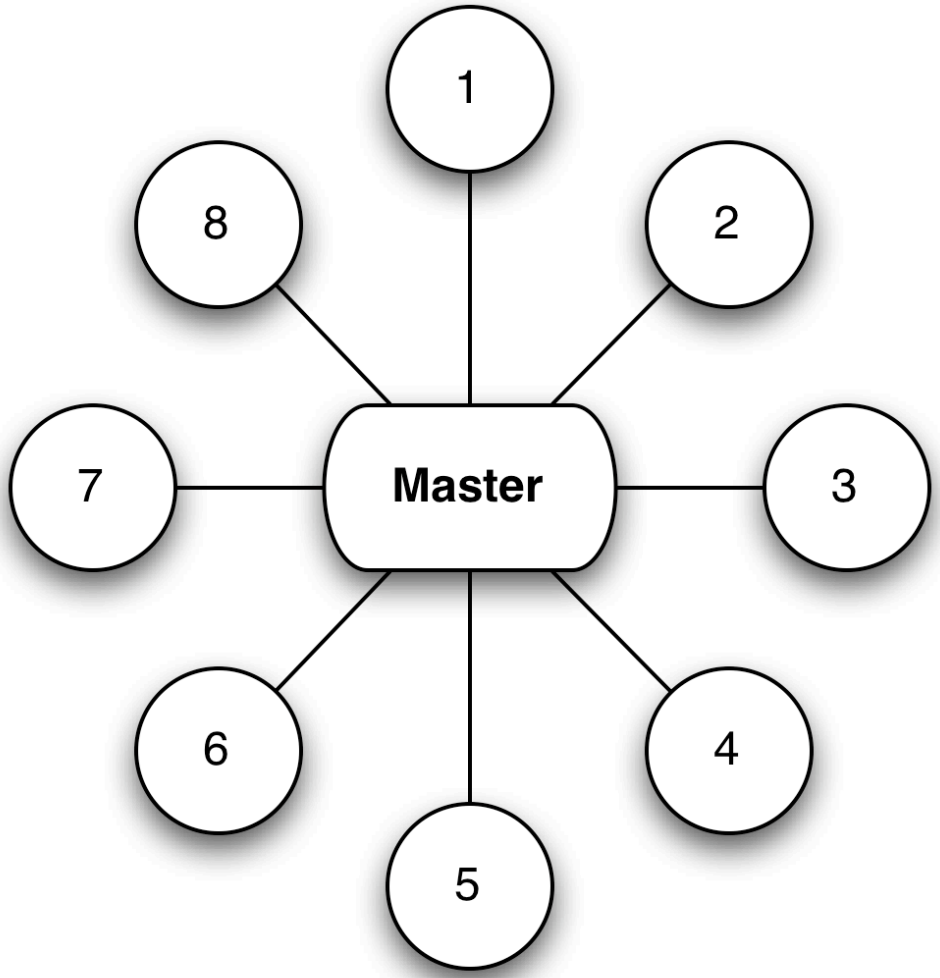

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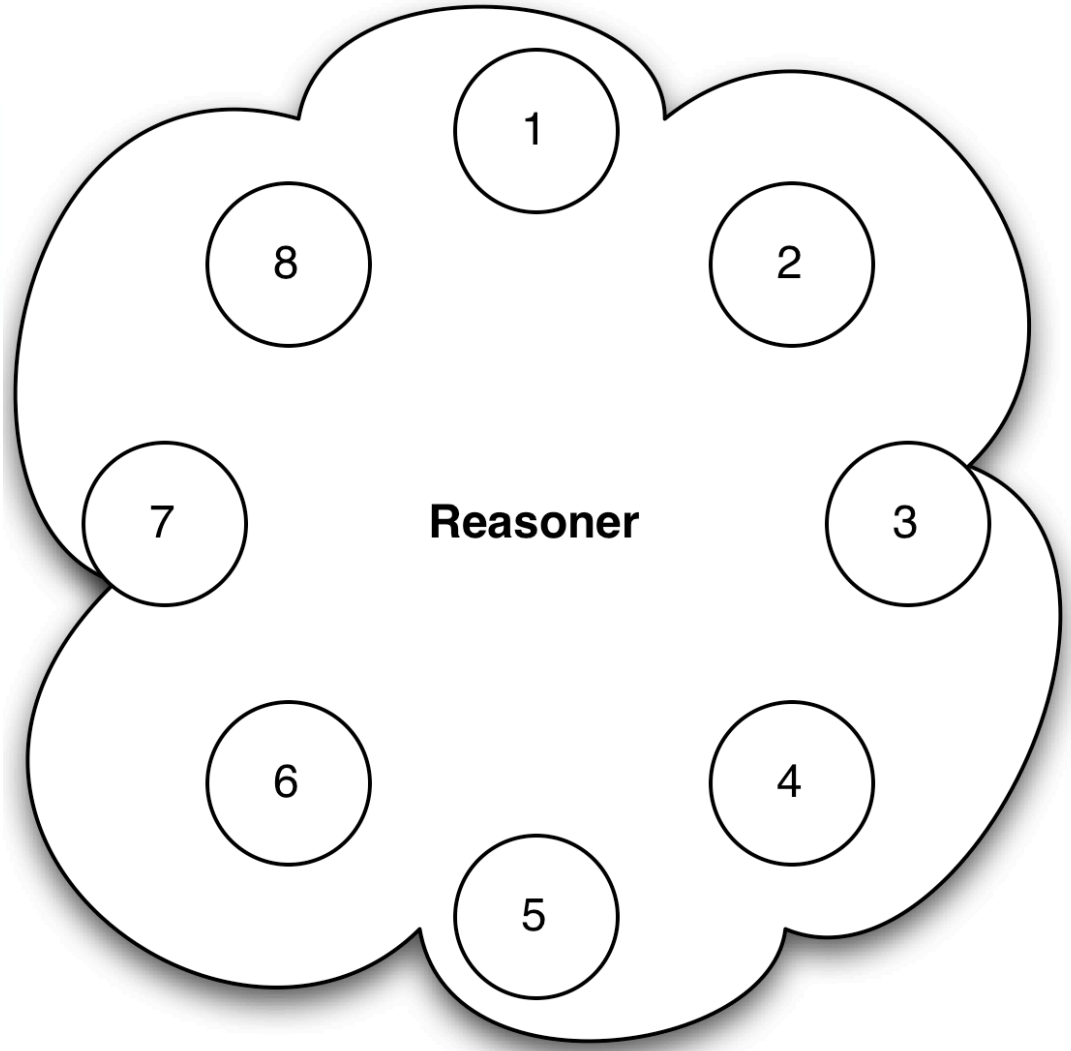

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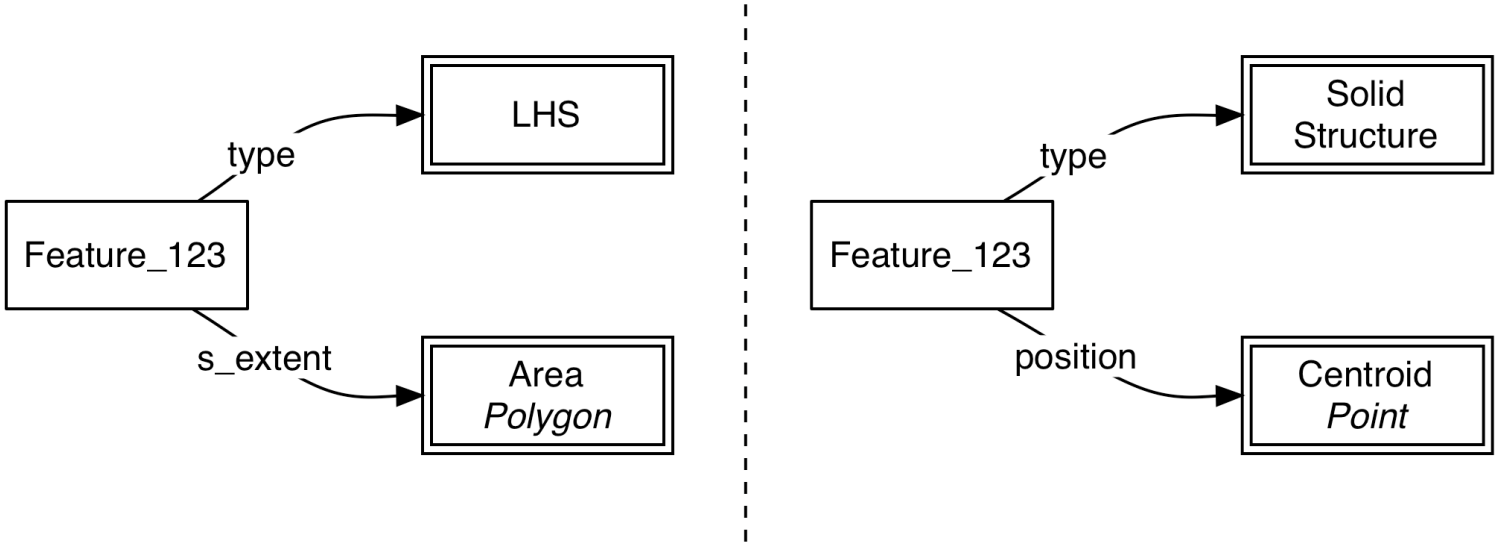

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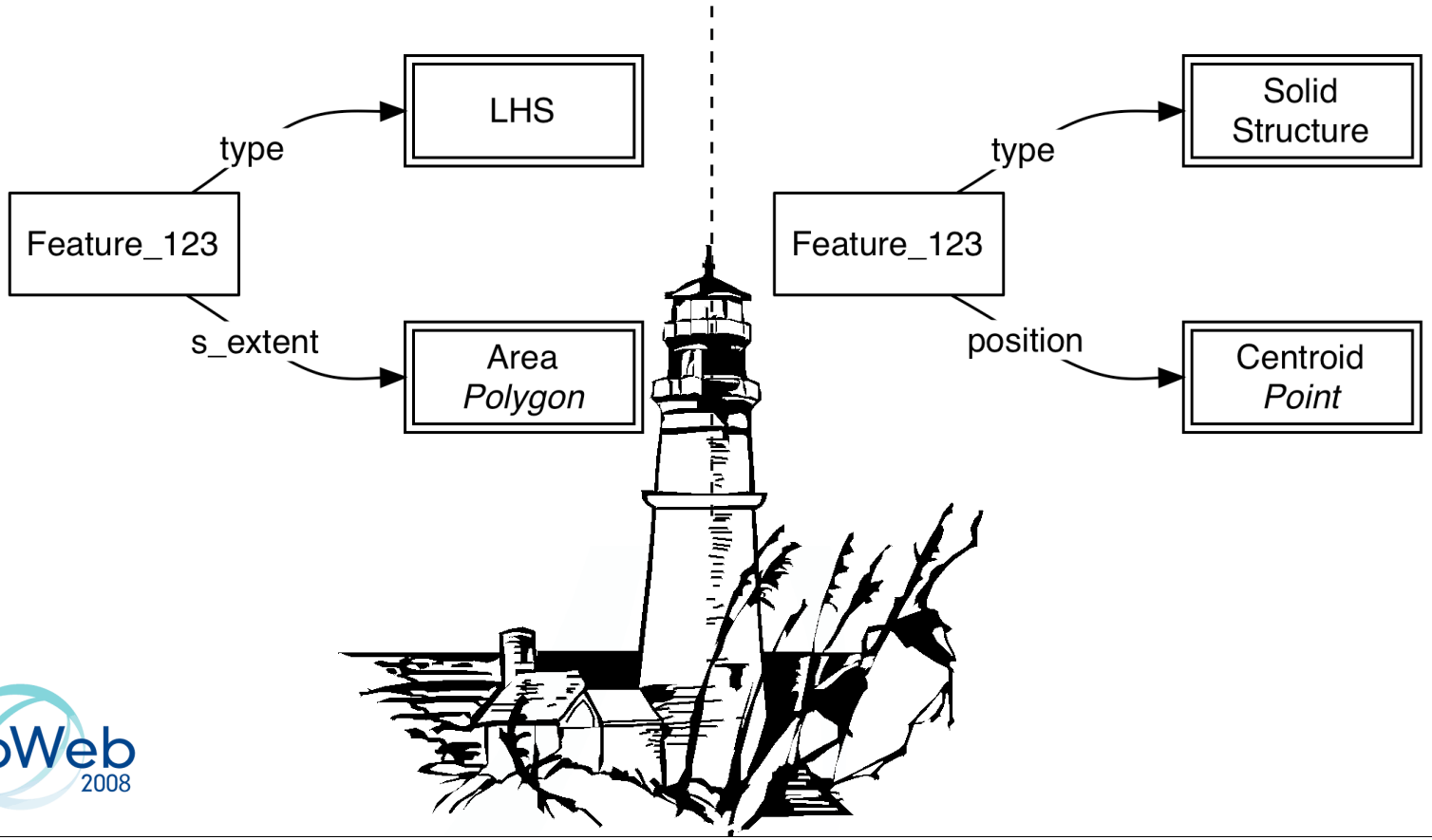

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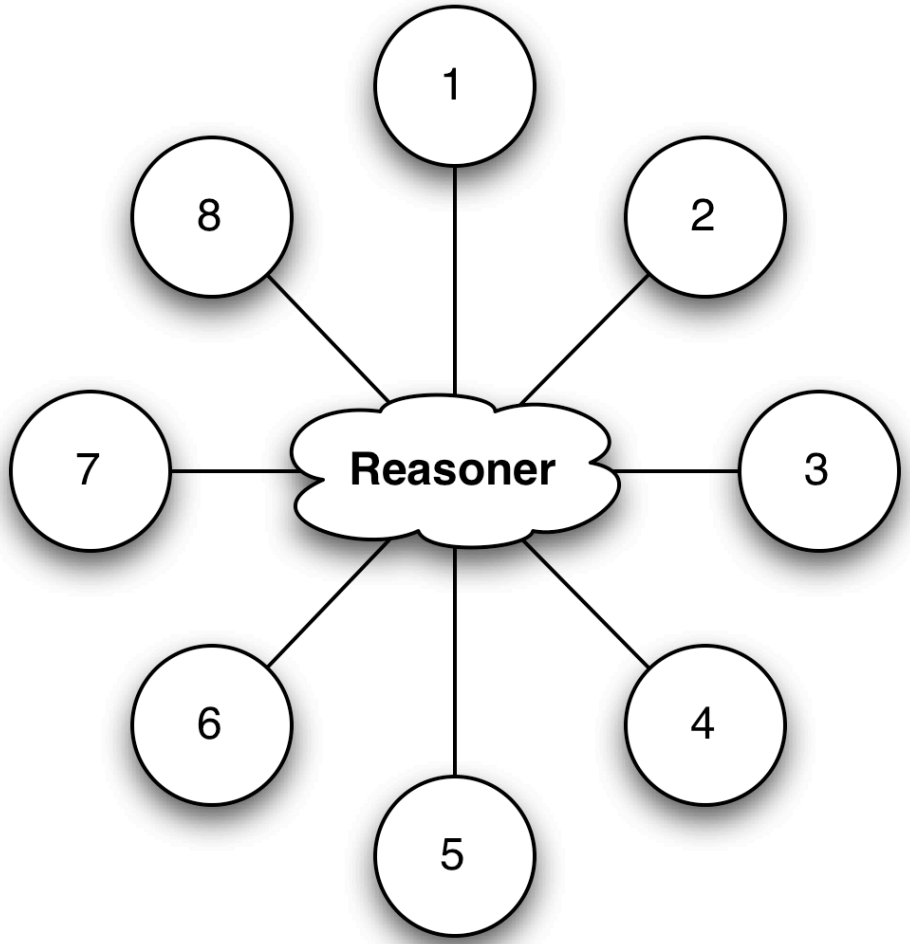

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Ontologies

- Description of a shared conceptualization
- Logic-based knowledge representation paradigm
- Annotate data with machine-readable knowledge
- Describe concepts (classes of objects) and their relations

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Ontology

```
concept Human
      nonFunctionalProperties
            dc#description hasValue "concept of a human being"
      endNonFunctionalProperties
      hasName ofType foaf#name
      hasParent inverseOf(hasChild) impliesType Human
      hasChild impliesType Human
      hasAncestor transitive impliesType Human
      hasWeight ofType (1) _decimal
      hasWeightInKG ofType (1) _decimal
      hasBirthdate ofType (1) _date
      hasObit ofType (0 1) _date
      hasBirthplace ofType (1) loc#location
      isMarriedTo symmetric impliesType (0 1) Human
      hasCitizenship ofType oo#country
      isAlive ofType (1) _boolean
                  nfp
                        dc#relation hasValue {IsAlive}
                  endnfp
```

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Ontologies

- "Queen-size bed"
  - Meant for one person
  - Fits two
  - Smaller than a "King-size bed"
  - Equivalent to a "double-bed"
- Enables automatic reasoning

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Ontologies

- Can serve as repositories of definitions
- Concepts defined in different ontologies can be linked

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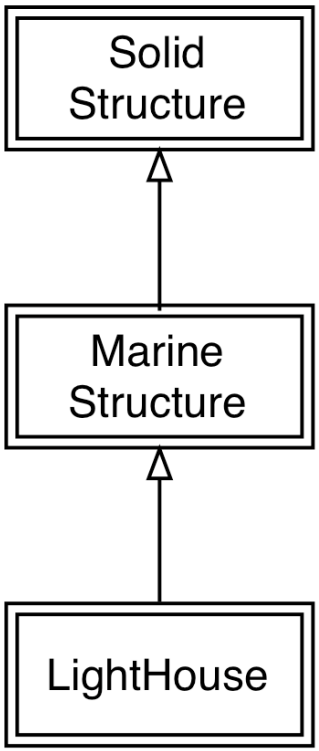
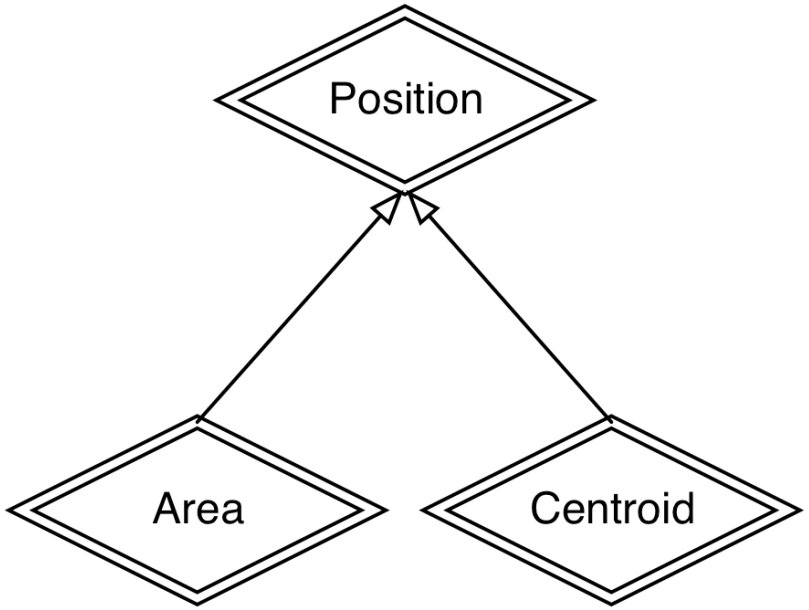
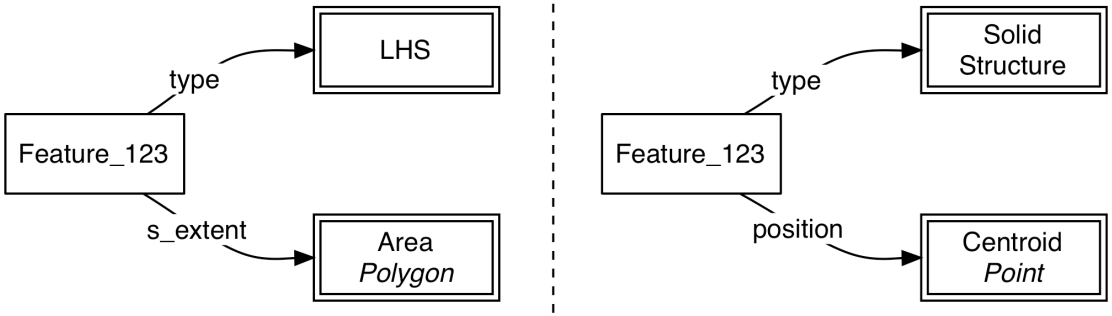
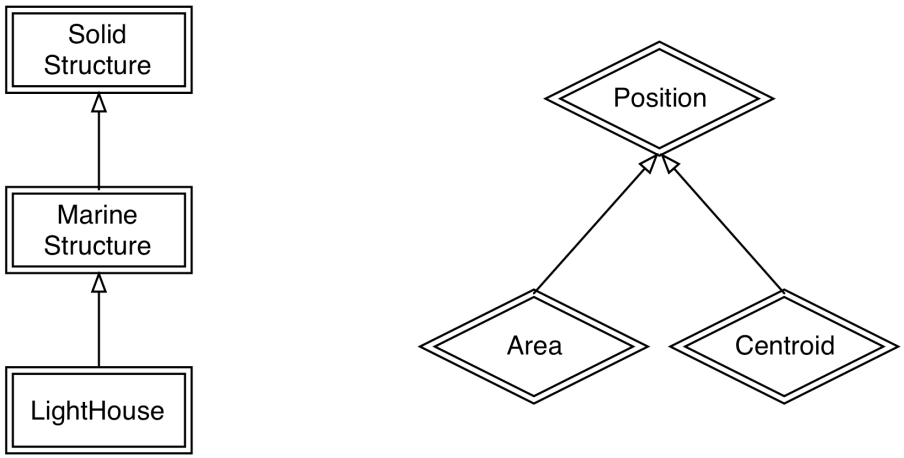
Cartography revisited





Cartography revisited





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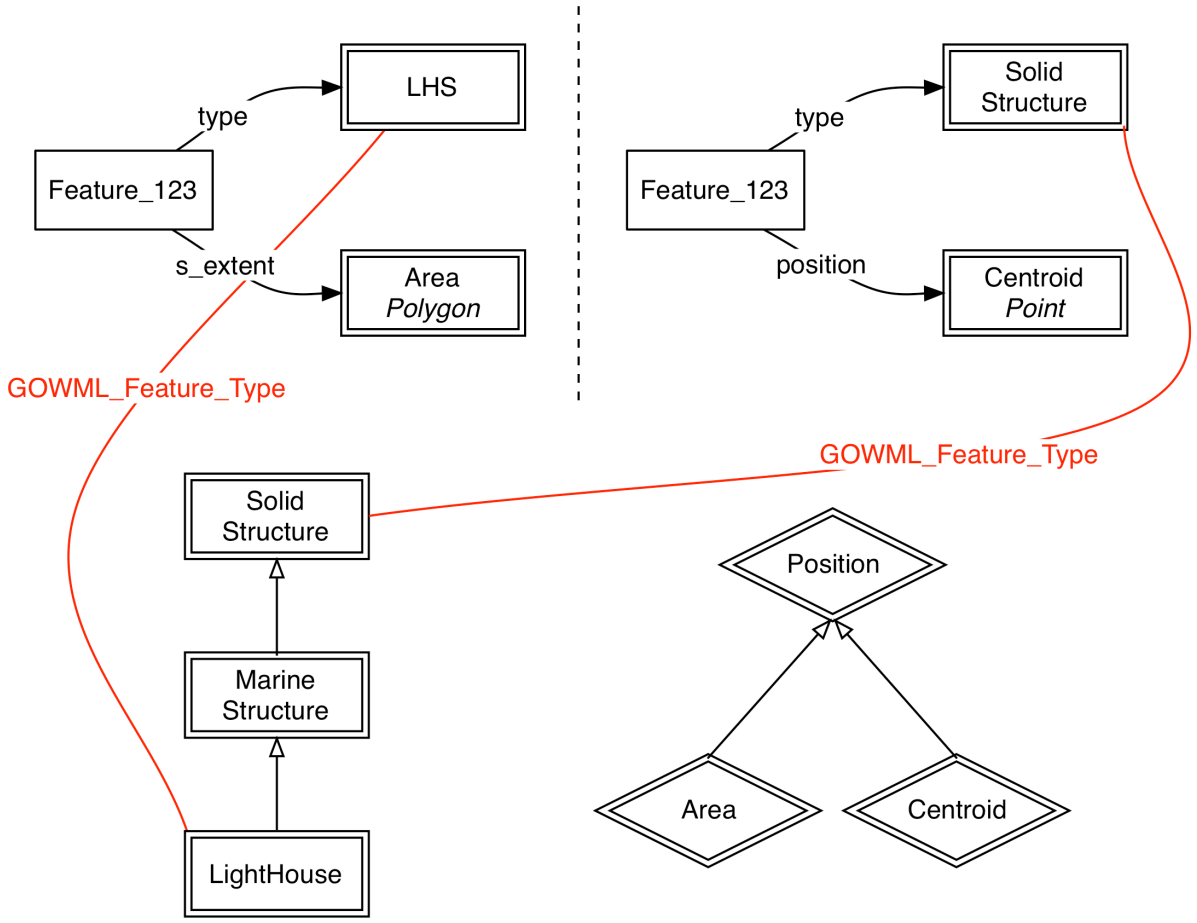
Cartography revisited



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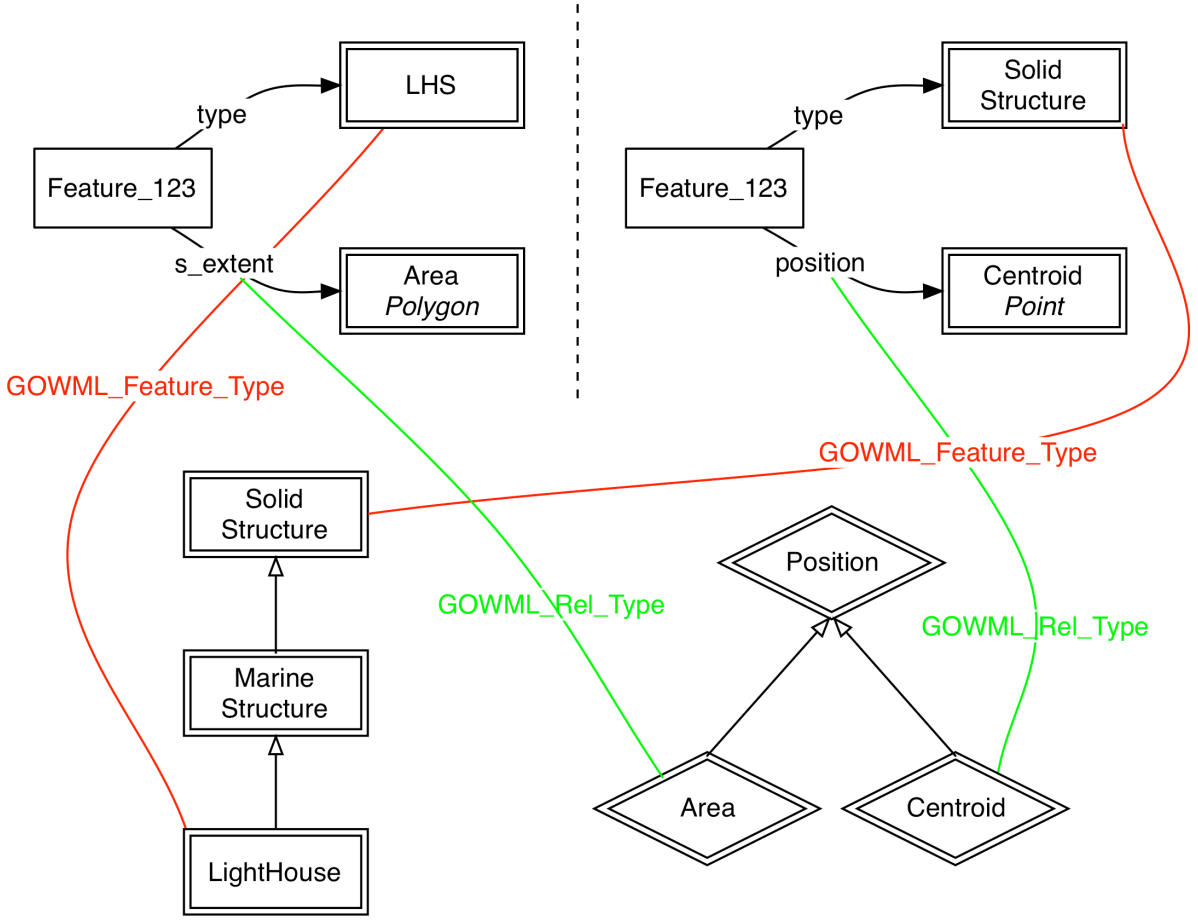

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Algorithm

- Use concept definition of features, properties and enumerated values to build a transformation between source and destination format
- Implemented using GML, OWL and XSLT

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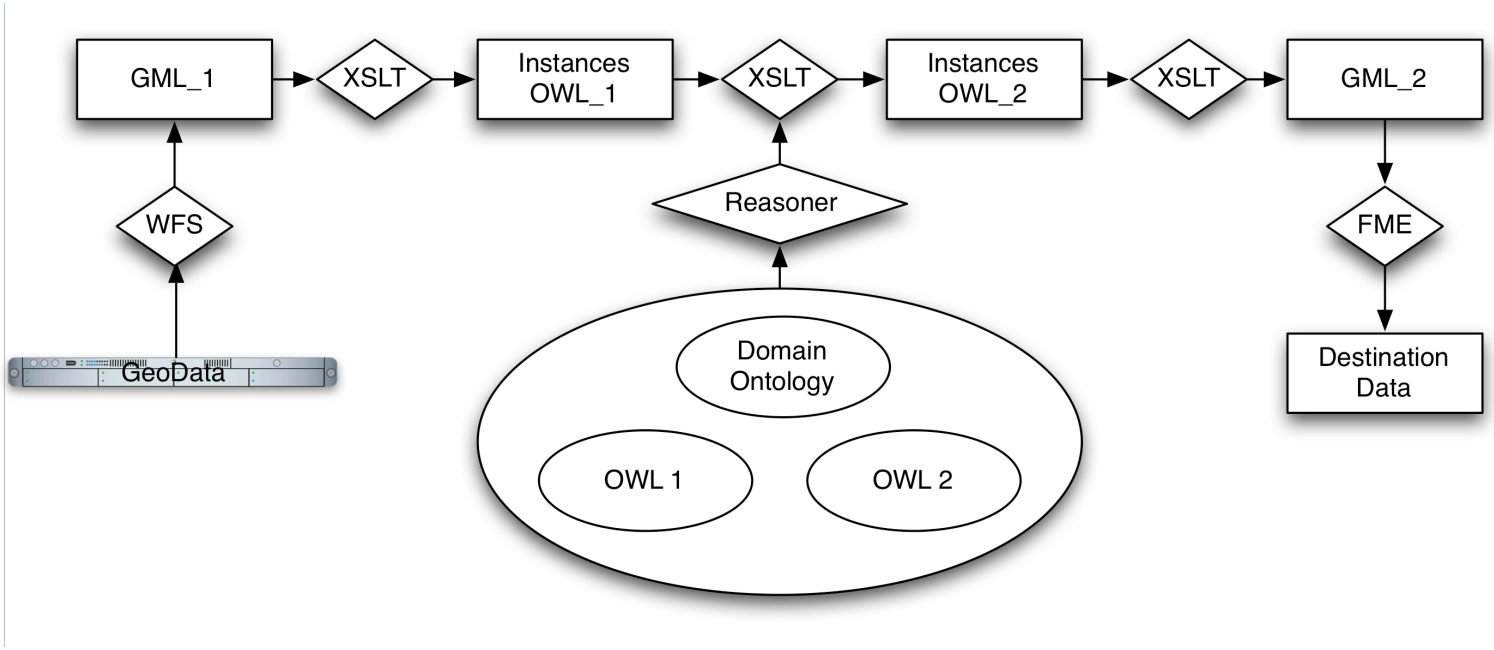
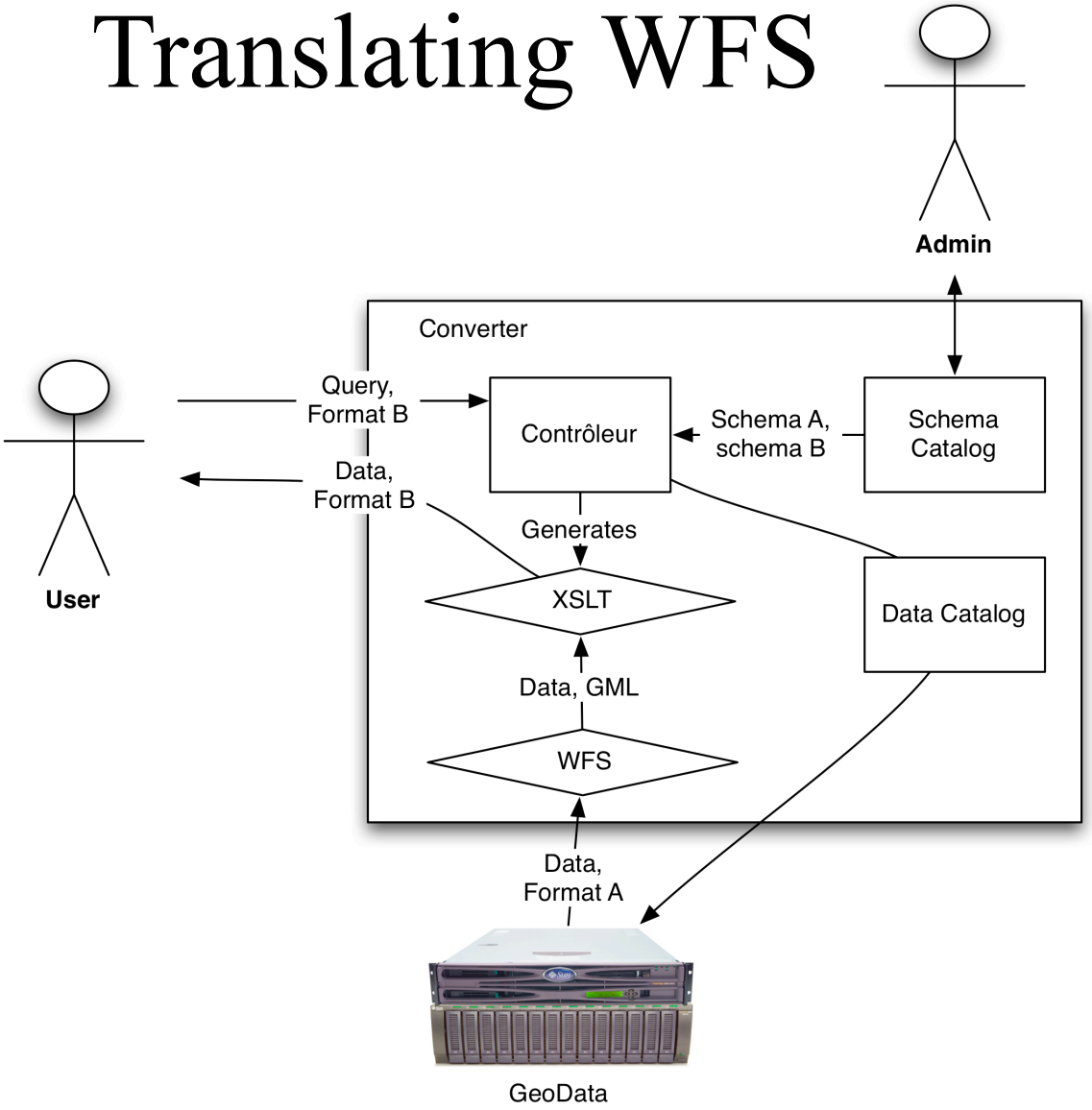
Translation



Translating WFS



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Consequence

- Data providers can make their data interoperable simply by mapping their database schema with the domain ontology
- Translation looses as little information as possible

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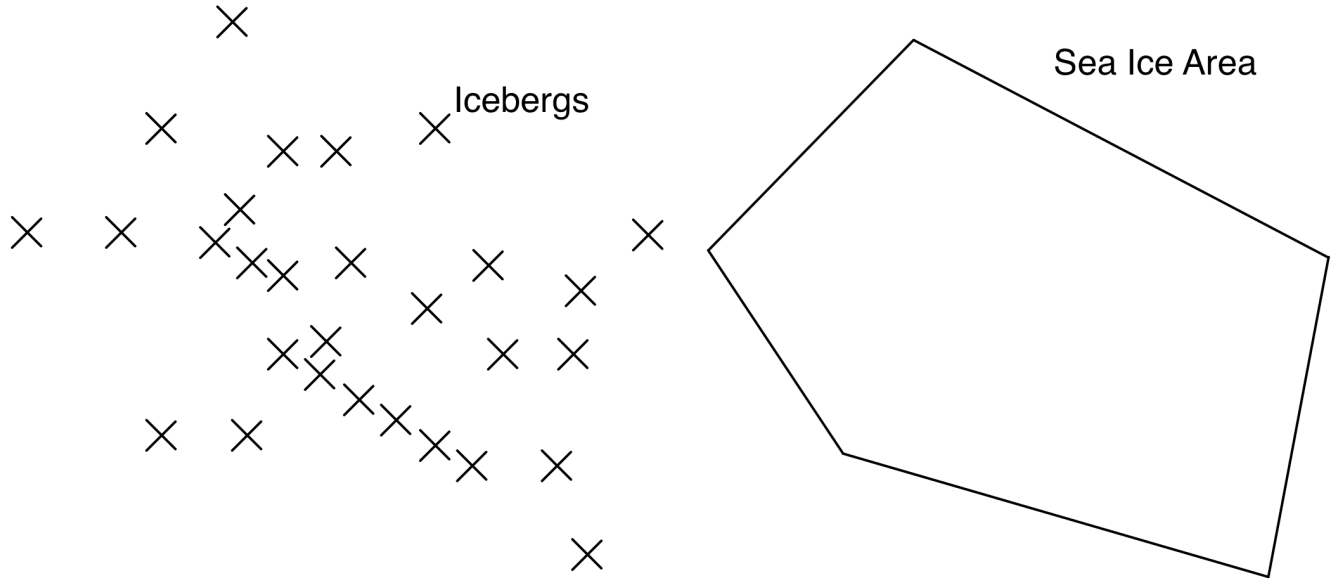
Caveats

- Not very fast – interactive use not yet evaluated
- …because we don't currently translate queries
- General-purpose reasoners tricky to use
- Spatial reasoning still exploratory

Spatial Reasoning



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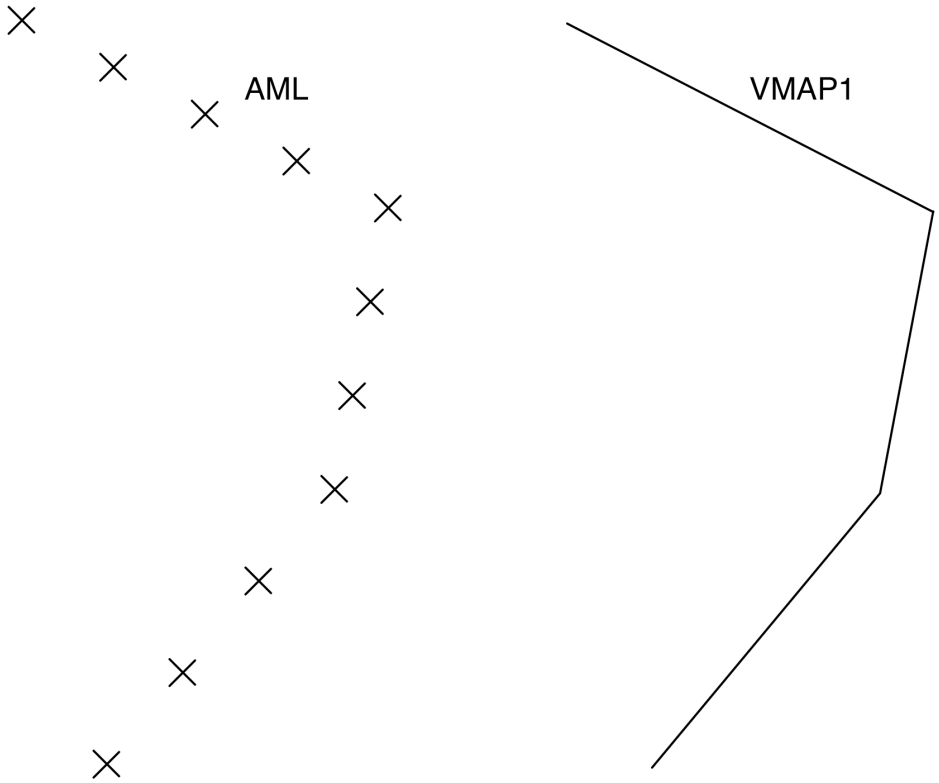
Spatial Reasoning



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GeoWeb 2.0

- Publishing content should be enough for it to reach consumers
- This can’t be done without standards
- Organisation are reluctant to adopt standards

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Conclusion

- Interoperating numerous databases is getting easier
- Semantic technologies help
- Still many practical problems
- With further research, exciting applications are just around the corner

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