Towards a Geographic Ontology Reference Model for Matching Purposes

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The need for a geographic ontology model
- Ontology matching context

The ontology model

Example

Conclusions and future directions
Introduction

- Ontologies used for many purposes
- For conventional ontologies, W3C standards are enough
  - OWL
  - RDF / RDFs
- Particularities of geographic information
  - Geometry
  - Location
  - Temporality
- However, conventional ontologies are not expressive enough
Introduction

- Need for a real spatio-temporal ontology
- Current geographic ontology efforts
  - GML in OWL
  - ISO 19109
  - Academical initiatives
Introduction

- Geographic matching context
  - Identify how much two elements information items (classes or data) are similar
  - Geographic information may come in different representations
  - Ontology is a mean of representing the information in a unique format
The ontology model

Ontology $O = \langle C, P, I, A \rangle$

- C is the set of concepts
- P is the set of properties
- I is the set of instances
- A is the set of axioms
The reference model

Context of a concept

- \( \text{ctx}(c) = <t(c), \{p(c)\}, \{x(c)\}> \)
  - \( t(c) \) is the concept identifier
  - \( p(c) \) is a property associated to the concept
  - \( x(c) \) is an axiom associated to the concept
The reference model

- Types of concepts
  - Domain concept (conventional) \rightarrow c
  - Geographic domain concept \rightarrow gc
  - Geometry concept \rightarrow geo
    - point, line, polygon
  - Time concept \rightarrow time
    - instant, period
The reference model

[Diagram showing a reference model with concepts such as Time, DomainConcept, Geometry, Instant, Period, GeographicDomainConcept, Metadata, Line, Point, Polygon, conventionalRelationship, spatialRelationship, and hasGeometry.]
The reference model

- **Property** \( p = <t(p), pd, \text{minCard}, \text{maxCard}> \)
  - **Data type** \( p = <t(p), dtp> \)
    - Attribute
    - Positional
  - **Object type** \( p = <t(p), gx, \text{minCard}, \text{maxCard}> \)
    - Conventional relationship: \( cr = (p \in P \mid gx : \neg gc) \)
    - Spatial relationship: \( sr = (p \in P \mid gx : gc) \)
    - Geometric relationship: \( ge = (p \in P \mid (gx:geo) \land \text{minCard} = 1) \)
    - Temporal relationship: \( tr = (p \in P \mid gx : time) \)
The reference model

- **Axioms**
  - Hierarchical relationships
  - Association between a concept and its instances
  - Restrictions over concepts
The reference model

- Instance $I = \langle t(c), t(i), VP, vMD \rangle$
  - $t(c)$ name of the concept being instantiated
  - $t(i)$ unique identifier of the instance
  - $VP$ values of the properties associated to the concept
    - $vp = \langle t(p), val \rangle$
  - $vMD$ value for the metadata
    - $vp = \langle t(mtd), val \rangle$
The reference model
The reference model

- Geographic region
  - Instances from a limited region
  - Covers all the instances from a set (MBR)
  - Use
    - Notion of region similarity
    - Accelerate the matching process
The reference model

- Metadata
  - Crucial for correct comparison
    - Coordinate reference system
    - Projection system
    - Scale
    - Acquisition / generation date
Example
Example
Conclusions

- Definition of a model for geographic matching purposes
  - Geographic, geometry and time concepts
  - Geographic instances
  - Geometric, temporal and spatial relationship properties
  - Constraints as ways of defining the ontology concepts
- Creation the Geographic Region notion
- What comes after
  - Development of a more sophisticated ontology based on the model
    - Reference ontology for the matching process
Thank you

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