Towards a Geographic Ontology Reference Model for Matching Purposes

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Agenda

- Introduction
  - 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 initiavives

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 = <C, P, I, A>**

- 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

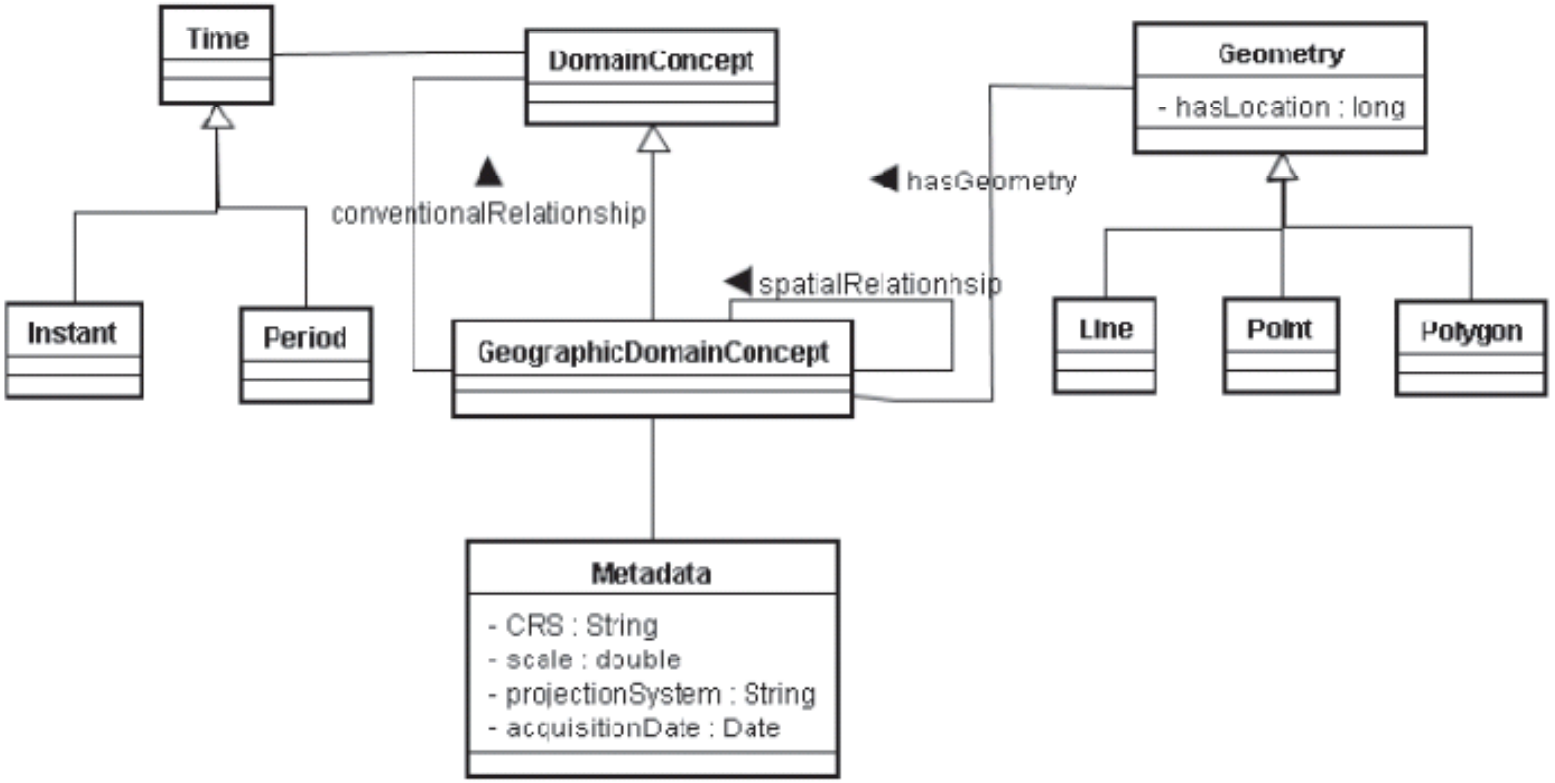
Context of a concept

- **`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) → c
  - Geographic domain concept → gc
  - Geometry concept → geo
    - point, line, polygon
  - Time concept → time
    - instant, period

The reference model



The reference model

- Property **p = <t(p), pd, minCard, maxCard>**
  - Data type **p = <t(p), dtp>**
    - Attribute
    - Positional
  - Object type **p = <t(p), gx, minCard, maxCard>**
    - Conventional relationship: **cr = (p ∈ P | gx : ¬ gc)**
    - Spatial relationship: **sr = (p ∈ P | gx : gc)**
    - Geometric relationship: **ge = (p ∈ P |(gx:geo) ∧ minCard = 1)**
    - Temporal relationship: **tr = (p ∈ P | gx : time)**

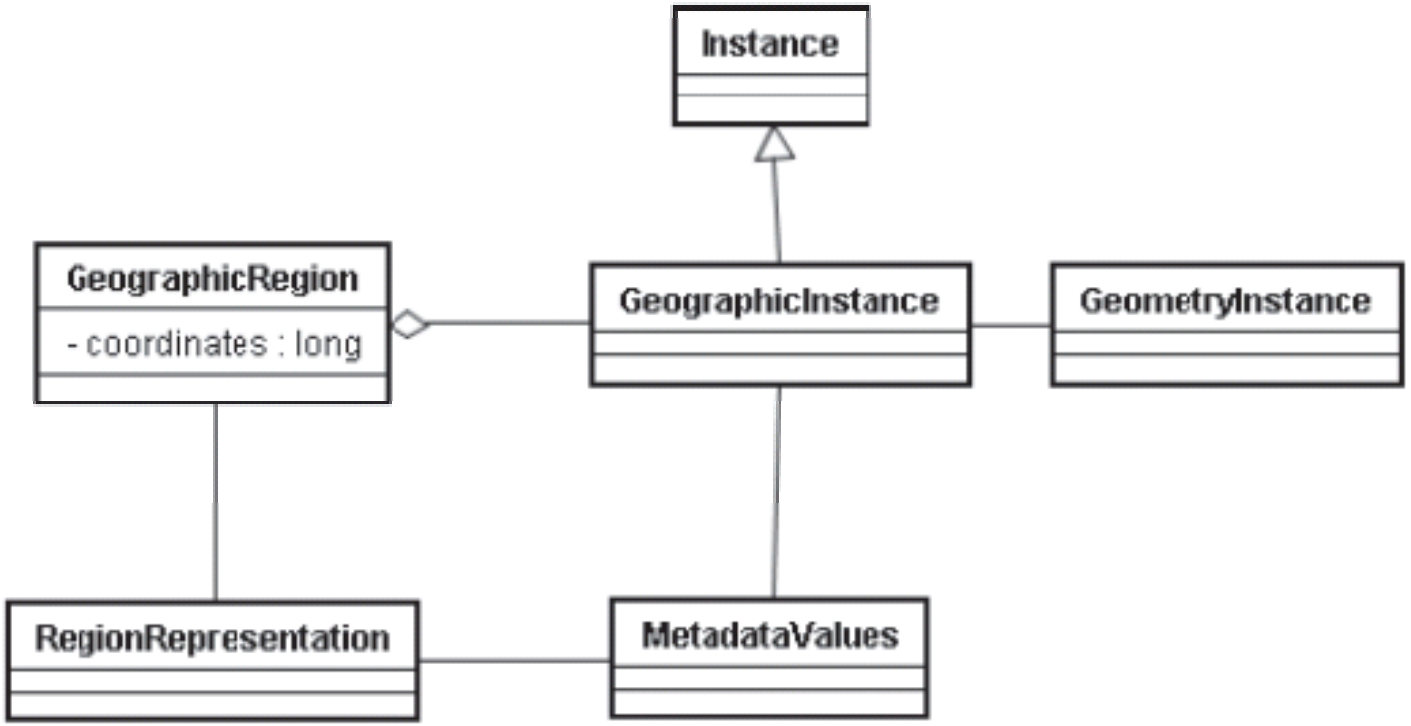
The reference model

- Axioms
  - Hierarchical relationships
  - Association between a concept and its instances
  - Restrictions over concepts

The reference model

- Instance **I = <t(c), t(i), VP, vMD>**
  - 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 = <t(p), val>**
  - vMD value for the metadata
    - **vp = <t(mtd), val>**

The reference model



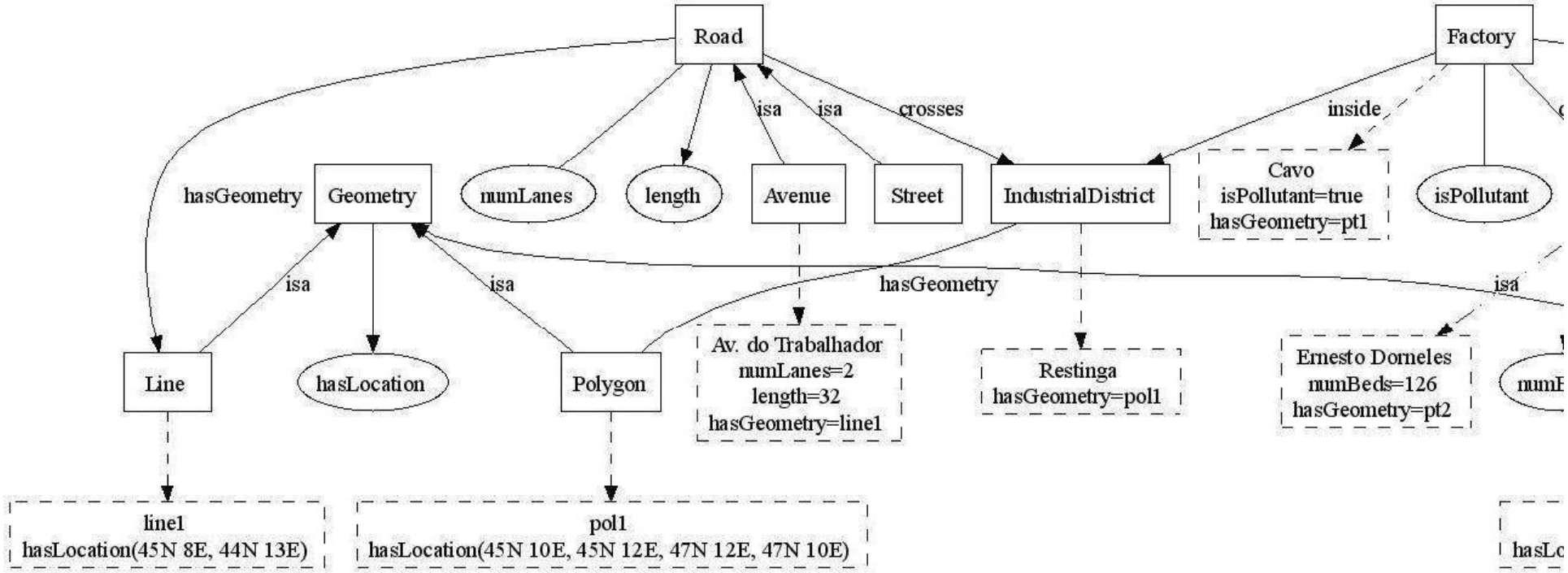
The reference model

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

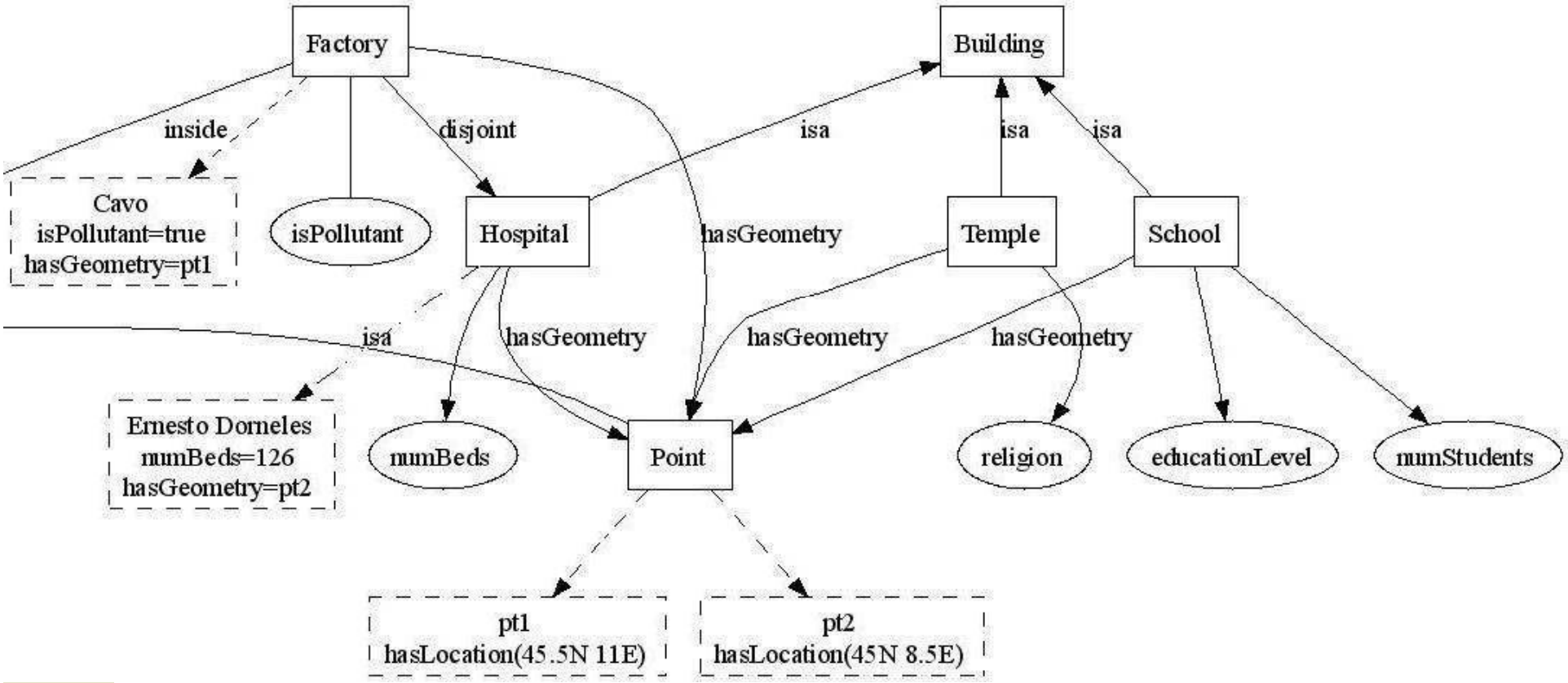
The reference model

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

Example


Road
Factory
hasGeometry
Geometry
numLanes
length
Avenue
Street
IndustrialDistrict
isa
isa
crosses
inside
Cavo
isPollutant=true
hasGeometry=pt1
isPollutant
isa
isa
hasGeometry
isa
Line
hasLocation
Polygon
Av. do Trabalhador
numLanes=2
length=32
hasGeometry=line1
Restinga
hasGeometry=pol1
Ernesto Dorneles
numBeds=126
hasGeometry=pt2
line1
hasLocation(45N 8E, 44N 13E)
pol1
hasLocation(45N 10E, 45N 12E, 47N 12E, 47N 10E)

Example


Factory
Building
inside
disjoint
isa
isa
isa
Cavo
isPollutant=true
hasGeometry=pt1
isPollutant
Hospital
hasGeometry
Temple
School
isa
hasGeometry
hasGeometry
hasGeometry
Ernesto Dorneles
numBeds=126
hasGeometry=pt2
numBeds
Point
religion
educationLevel
numStudents
pt1
hasLocation(45.5N 11E)
pt2
hasLocation(45N 8.5E)

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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