Rules for Geospatial Semantic Web Applications

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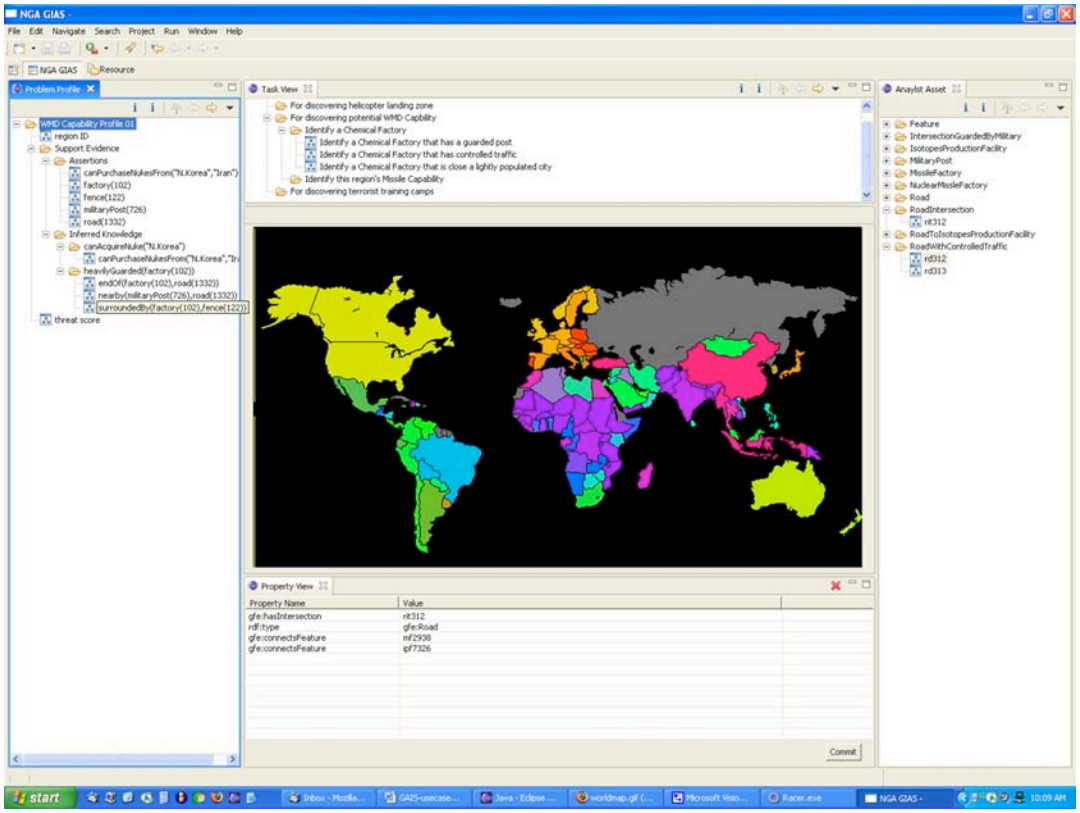
Objectives

- Describe the use of rules in Geospatial Semantic Web application
- Discuss language requirements for expressing geospatial inference rules
- Discuss tools requirements for processing geospatial inference rules
- Highlight open questions associated with the use of rules in geospatial applications

Geospatial Semantic Web

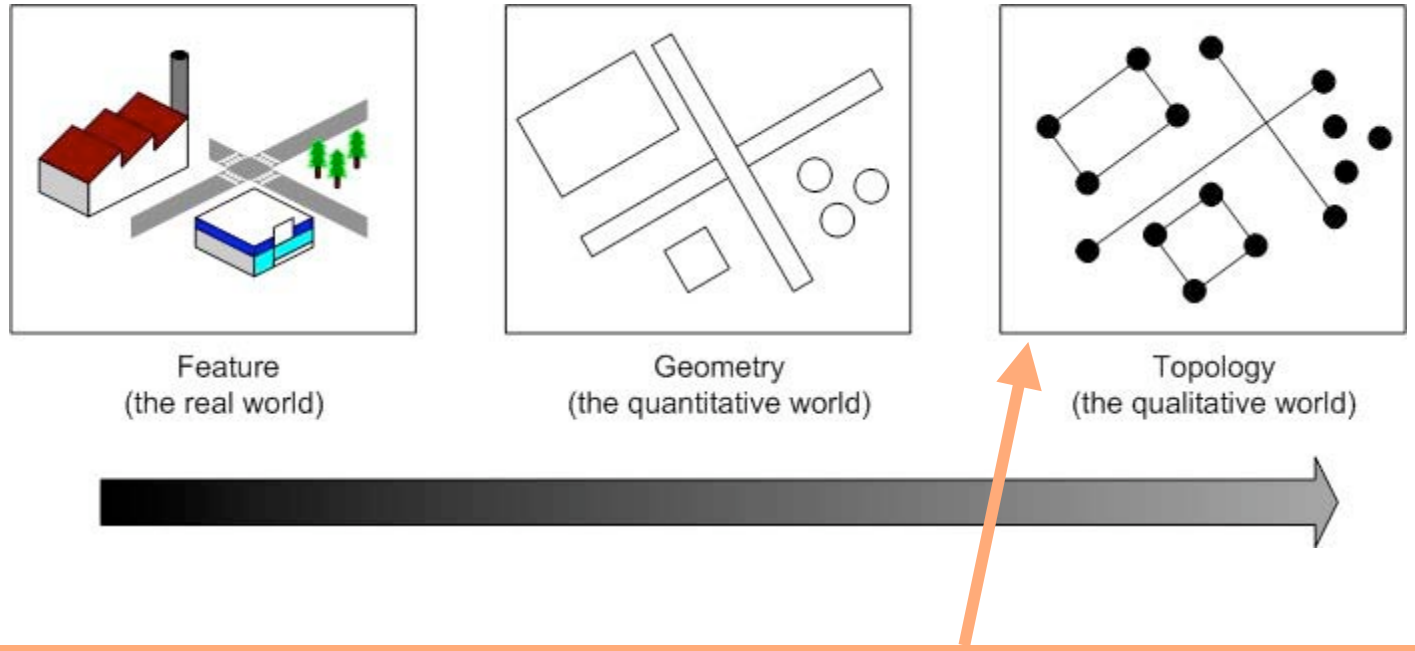
- Geospatial Semantic Web is a natural extension of the current geospatial systems and applications
- Key focuses
  - Enable data interoperability by exploiting semantic web languages and ontologies
  - Automate the production of geospatial knowledge by using rules and OWL inferences

An Intelligence Analyst Application



- Help intelligence analysts to solve problems using different types of geospatial knowledge
- E.g. Discover WMD capabilities of a country by comparing the collected data with the known WMD signature information

Geospatial Models



Typically, we do reasoning in this world with rules!

Rules Usage Examples

- Assumption: all geospatial data are expressed in OWL/RDF based on some shared ontology
- Enable data interoperability
  - Using rules to convert data from one geometry representation to another geometry representation
  - Using rules to unify Unit of Measurements
- Automate geospatial knowledge production
  - Define rules for topological reasoning (e.g. Region Connection Calculus, Allen's Interval Calculus)
  - Define rules for bridging geometry reasoning and topological reasoning

Rule Language Requirement

- Support for N-ary representation
  - Not all geospatial relations are binary.
    - distanceFrom (?locA, ?locB, 200m)
- Support for mapping data from the RDF representation to other rule engine specific representation
  - Classical rule engines may be needed to support default reasoning, fuzzy reasoning
  - It's inconvenient to write rules that involve a large number of N-Triples

Rule Processing Requirement

- When processing certain geospatial inference rules, a rule engine may be required to preprocess the associated rdf:Resource.
  - IF distanceFrom(?locA, ?locB, 200m)
    THEN do_some_work()
  - Must extract geometry information of the rdf:Resource that are bound to ?locA and ?locB
- Integrate the representation of “functors” (built-ins) as RDF properties
  - (?geoA geo:within ?geoB)
  - (?a geo:within ?c) <- (?a geo:within ?b), (?b geo:within ?c)
  - If “geo:within” is a functor, what should be the caching policy, and when should the engine do triple evaluations rather than calling the functor?

Open Question: Contexts

- Geospatial inference often involves context (location, time etc).
  - Rules for determining WMD facilities within a forest area might be different from those for determining WMD facilities within a desert area
  - Rules for determining WMD facilities during a winter season might be different from those for determining WMD facilities during a summer season
- Should rule representation include constructs for context representation?

Open Question: Constraint Rules

- Constraint rules are essential for geospatial representation and inference
  - E.g. The Helipad should be within the Security Fences of a potential WMD facility, and it should be at least 200 meters away from the fence
  - E.g. a potential WMD facility should not be within or partially within a flood plain.
- Should there be special constructs for representing constraint rules?

Open Question: Working with Imprecise Data

- An intelligence analyst rule:
  - Most WMD facilities are within 50Km of cities with populations equal to or greater than 10,000 population.
- How to define rules that can tolerate imprecise data that is measured from the real world?
  - What if facility(X) is within 50.05 Km of a city with population 9,999?
- How to define rules to deal with subjective concepts?
  - Nearby, far away, cold/warm, soon, later etc.

Questions?