

An ontology-based model for representing evolution of both data and semantic in GIS

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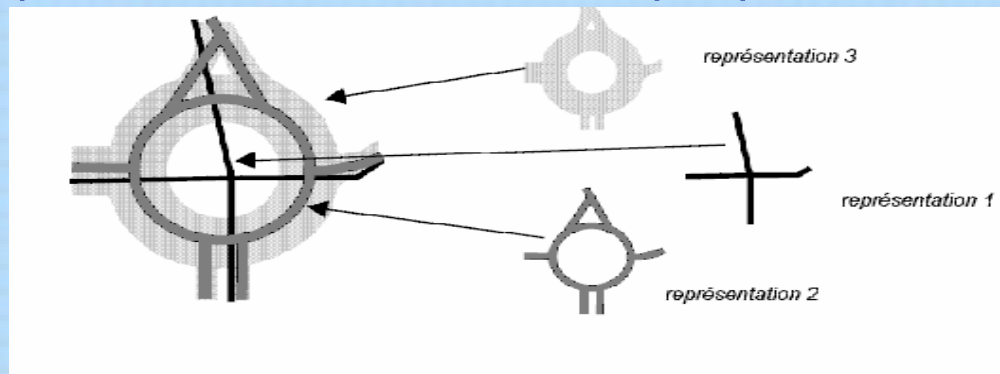
Introduction - GIS

- ◆ Geographic Information Systems
The goal of GIS is to provide information about a given space.
- ◆ Layers
Geographical objects organized in themes frequently represented as layers.
- ◆ Data in GIS
Objects are either spatial or spatio-temporal.



Introduction : Exigencies

- ◆ **Historicity**
Enrich spatial analysis by an evolutionary study of the considered objects.
- ◆ **Dynamicity**
Models should be able to represent the concept evolution through time.
- ◆ **Multi-Presentation, Multi-Resolution**
Geographical applications have strong requirements in terms of multiple presentations.



Related Work – Snapshot Model

- ◆ Snapshot Model (1988)
 - ◆ Time Stamping Layers
This model uses time-stamping layers that show the states of a geographic distribution, at a certain time.
 - ◆ Problems (complex queries, redundancy ...)



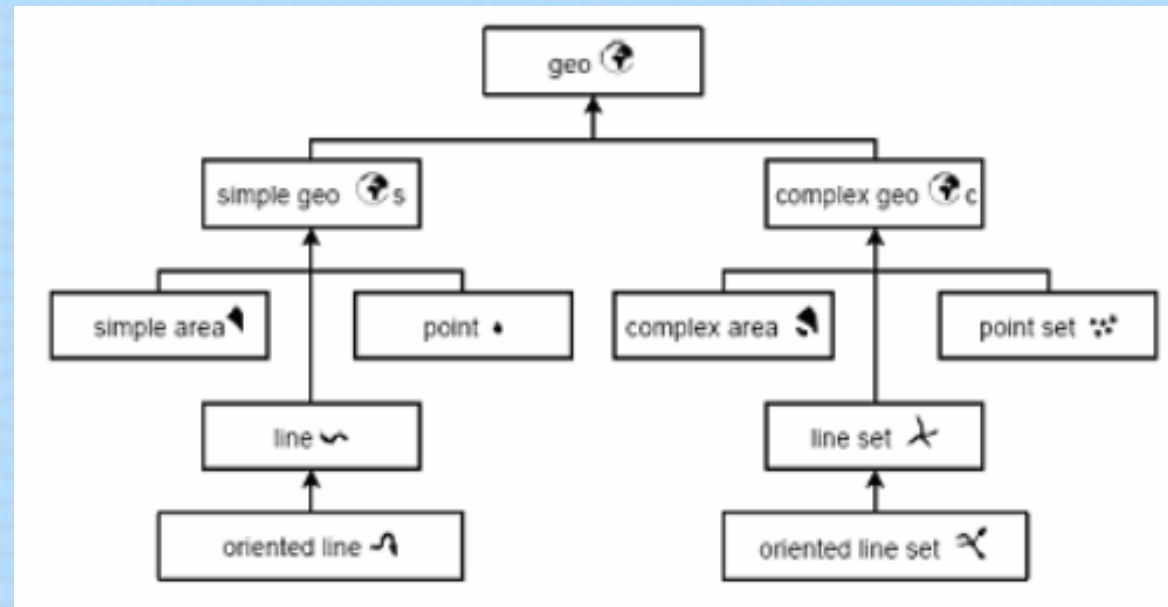
Related Work – Three Domain Model

- ◆ Three Domain Model (1994)
 - ◆ Three Dimensions (Semantics, Space and Time)
The semantic domain holds uniquely identifiable objects.
 - ◆ Improvements
 1. Handling Both movements and changes
 2. Handling simple and complex, temporal and spatio-temporal queries.



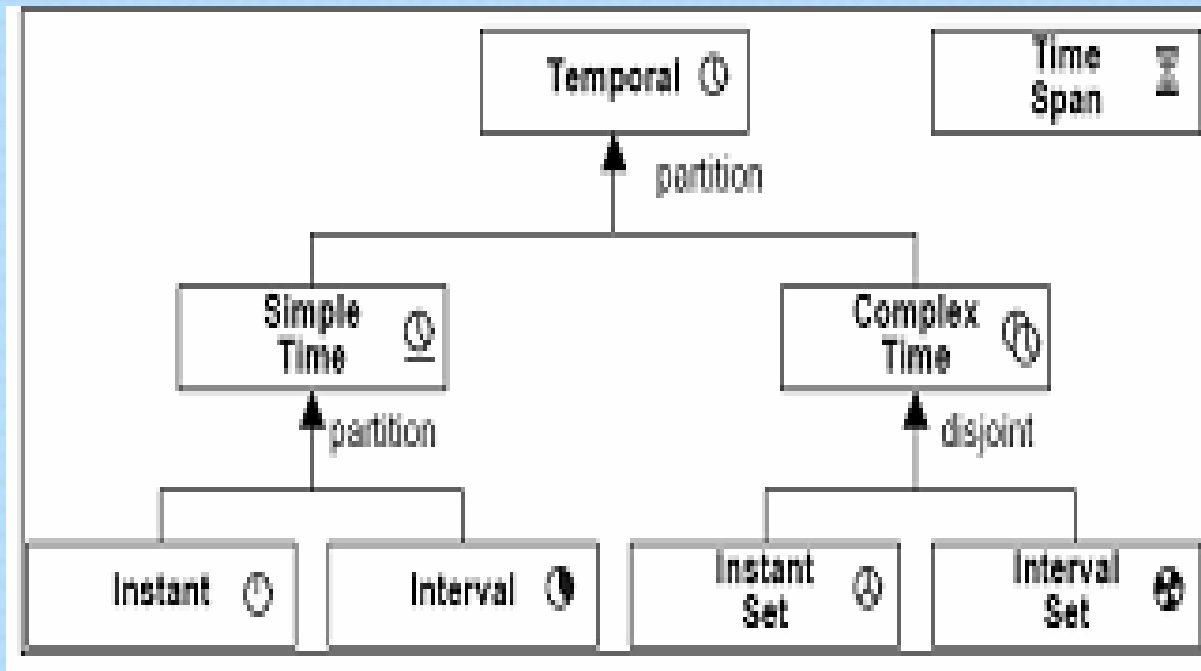
Related Work – MADS

- ◆ Modeling of Application Data with Spatio-Temporal features (1998)
- ◆ Spatial Data Types



Related Work – MADS

- ◆ Temporal Data Types



Related Work – MADS

- Dimensions (Spatial, Temporal, Structural).
- Multiple Perception using perception stamps.
- Multiple Presentation Techniques.
- Problems?
 - ◆ Closed World Assumption.
 - ◆ Impossible update of the Underlying model.



Related Work – Ontologies

- ◆ Definition
- ◆ Interesting features
- ◆ Advantages over the MADS model:
 - ◆ Open World Assumption.
 - ◆ Ability to update the conceptual model.



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Our Approach



Our Approach : Objective

- ◆ A new model that insures:
 - ◆ Multi-presentation of geographic objects.
 - ◆ Ability of Adding, removing, and changing concepts.
 - ◆ Keeping track of the historical data of instances and concepts.

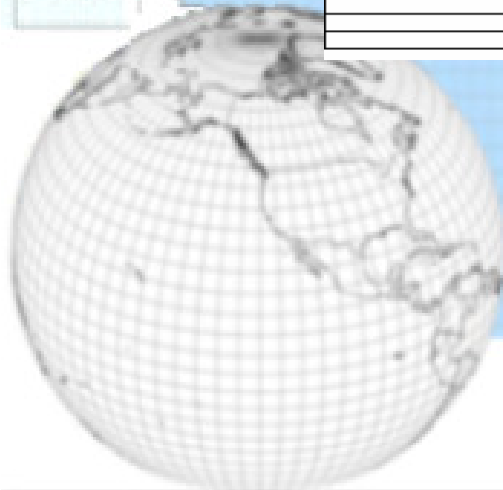
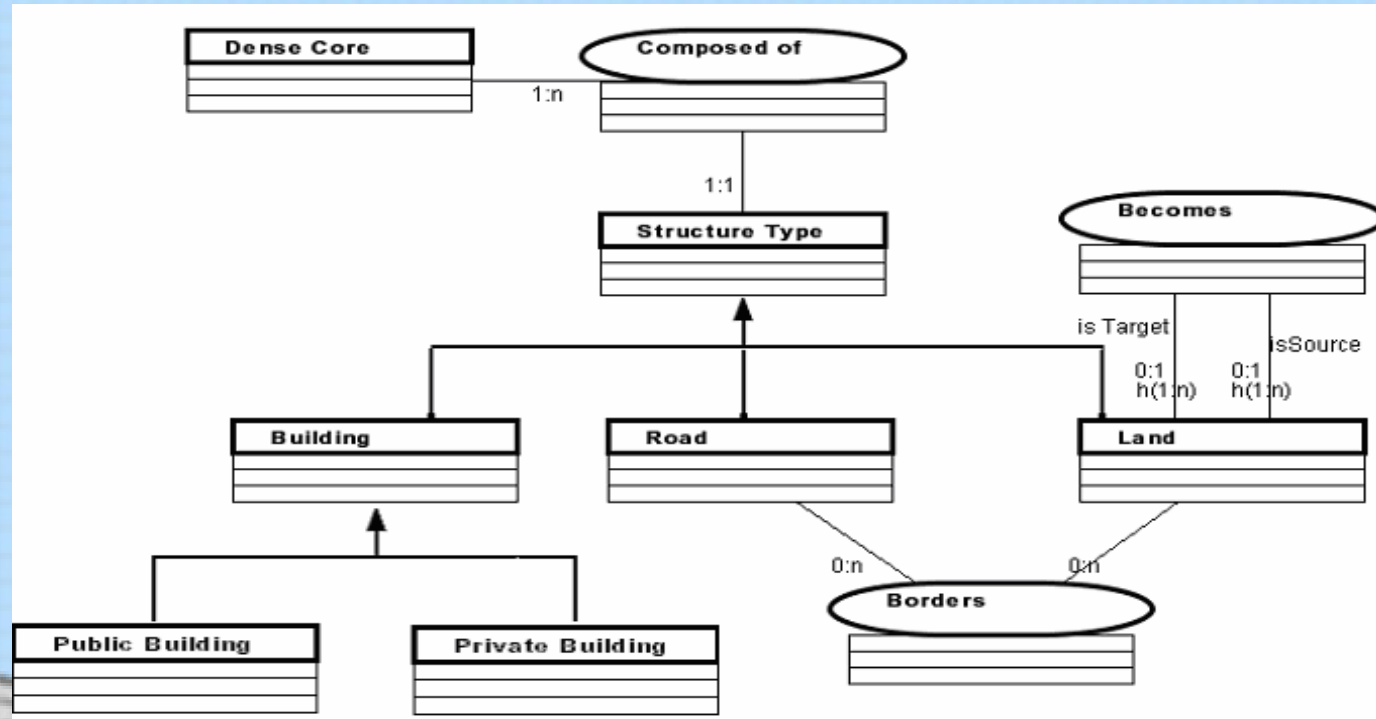


Our Approach: MADS + Ontologies

- ◆ Combining MADS and Ontologies.
 - MADS
 - Mapping MADS to an Ontology
 - History tracking



Example: MADS model



Example: MADS model

- ◆ A "Dense Core" is composed of "Structure Types".
- ◆ Structure Types are "Building", "Road" and "Land".
- ◆ Buildings can be public or private.
- ◆ Many lands may be joined together to form one land, or a land can be split in many smaller lands.
- ◆ Roads have borders with lands.



Example: Mapping MADS to Ontology

- ◆ Translating the MADS model into a web ontology language (OWL) using transformation rules.

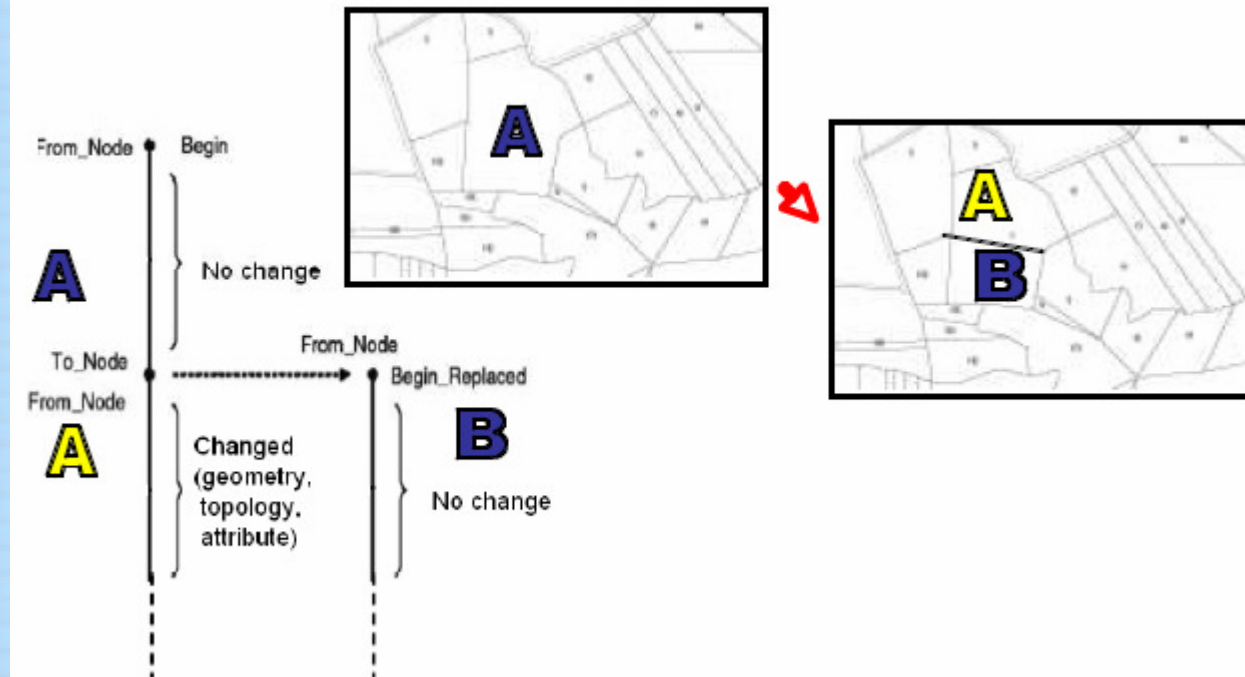


Example: History Tracking

- ◆ Object creation : “Begin”.
- ◆ A new entity derived from a previous existing object: “Begin-Replaced”.
- ◆ Each change will have a specific value (Change in geometry, in topology, in attribute, in geometry, in topology and attribute ...).
- ◆ Object Destruction: End



Example: History Tracking



Relationship 1: Value = "Begin", Start Node = "T1",
Finish Node= "T1", Instance ID = "Land A".

Relationship 2: Value = "No Change",...

Relationship 3: Value = "Change in Geometry and Topology",
Start Node = "T3", Finish Node= "T4",
Instance ID = "Land A"...



Conclusion

- ◆ A solution that allows the evolution of spatio-temporal data models in terms of concepts.
- ◆ Multiple models that contributed in this domain.
- ◆ MADS in detail, and his shortcomings.
- ◆ Combining MADS and Ontologies.
- ◆ Mapping the MADS model to a new ontology.
- ◆ Explicit temporal relationship in the ontology model.
- ◆ Future Works: Application of this model on the geographic data of Nantes.



Thank You For Your Attention

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