

Ontologies and Urban Databases

- 1 – Definitions of Ontologies
- 2 – Necessity of Ontologies for Urban Applications
- 3 – Why different!
- 4 – Towards Ontologies of Space
- 5 – My own vision of TOWNTOLOGY project

1 – Definition of Ontologies

- Οντος = Being ; Λογια = discourse
- **Def1**: theory of objects and of their relations
- **Def2**: theory concerning entities, and especially entities existing in languages
- **Def3**: An ontology is an explicit specification of a conceptualization (Gruber)

Definition

- Ontology (capital "o"):
 - a philosophical discipline.
- An ontology (lowercase "o"):
 - a specific artifact designed with the purpose of expressing the intended meaning of a vocabulary

Definition

- **Nicola Guarino** : *"An ontology is an engineering artifact, constituted by a specific vocabulary used to describe a certain reality, plus a set of explicit assumptions regarding the intended meaning of the vocabulary words"* (Guarino, 1998)

What is an ontology?

- A semantic network
- A formal description of a vocabulary
- According to Gruniger et al., ontologies can provide the following:
 - Communication between humans and machines,
 - Structuring and organizing virtual libraries, and repositories of plans,
 - Reasoning by inference, particularly in very large databases

What an **Ontology** is NOT!!!

- not a collection of facts arising from a specific situation
- not a model of an application domain
- not a database schema
- not a knowledge base
- not a taxonomy
- not a vocabulary or dictionary
- not a semantic net

Domain or application ontologies

- Building an ontology is similar to data conceptual modeling
- At application/domain level, an ontology can include constraints, rules and derived rules
- No storing problem

Different classifications (Kavouras)

Ontology	Category_type
CORINE Land Cover	Peat bog
	Water course
	Water body
MEGRIN	Bog
	Canal
	Lake/ pond
	Salt marsh
	Salt pan
	Watercourse
WordNet	Body of water
	Bog
	Canal
	Lake
	Pond
	Salt pan
	Watercourse
	Watercourse

2 – Necessity of Ontologies for Urban Applications

- Interoperability of urban databases
 - Ex. Road repairs
 - Ex. Environmental assessment
 - Ex. Regional studies
- Cooperation of various systems for providing new services
 - Location-Based Services
 - Ex. Transportation modes and cultural, sportive, activities



Example of cooperation (1/2)



- Going from the Da Vinci *Gioconda* in the Paris Louvres Museum, to the Madrid Prado Museum Velasquez *Meninas*
- How to generate the roadmap from one painting to another painting?
- Generation of a Physical Hypermedia link

Example of cooperation (2/2)

- From the Louvres database → exiting from the *Gioconda* to the next metro station
- From the Paris Transportation Company → going from the nearest metro station to Paris Airport
- From the Airlines database → going from Paris Airport to Madrid Airport
- From the Madrid Transportation Company → going from the airport to the nearest metro station
- From the Prado database → going from the nearest metro station to the *Meninas* painting

Example on roads

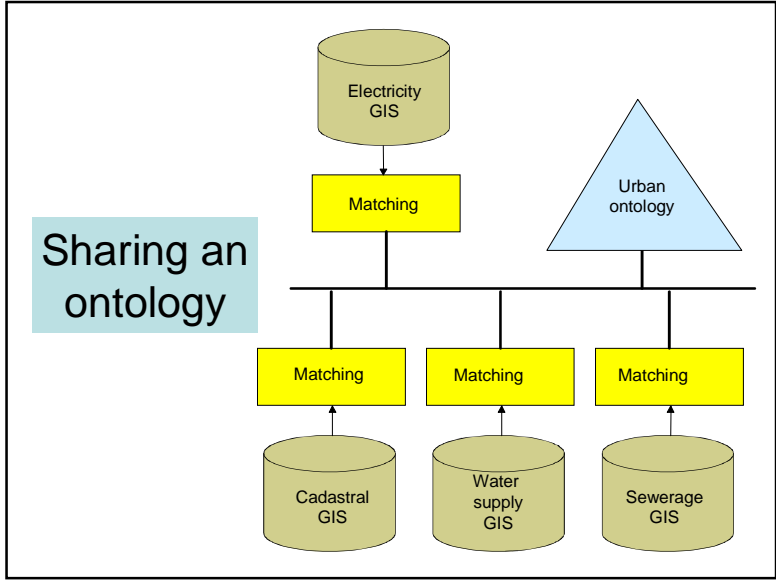
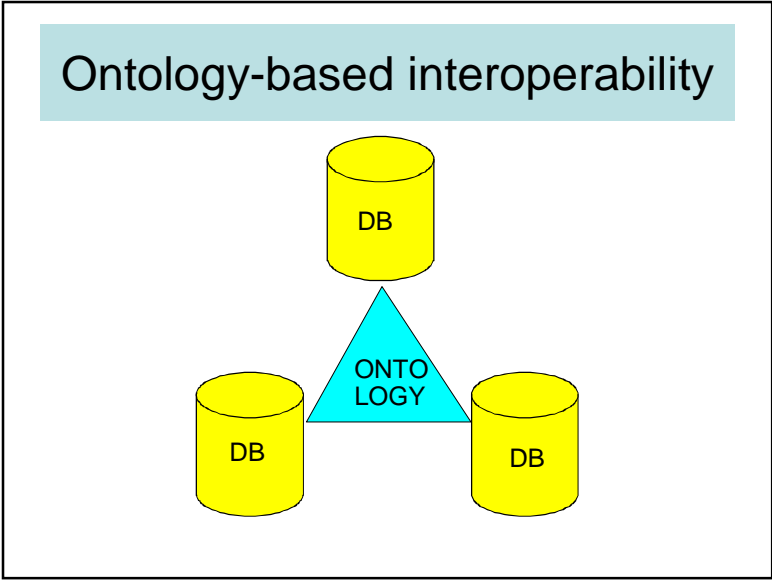
- Distance (km or miles) → syntactic
- Street, motorway → semantic
 - Motorways, Toll Motorways, Turnpikes
 - Autopistas, Autoroutes, Autostrade

Yes, we do have the road file!

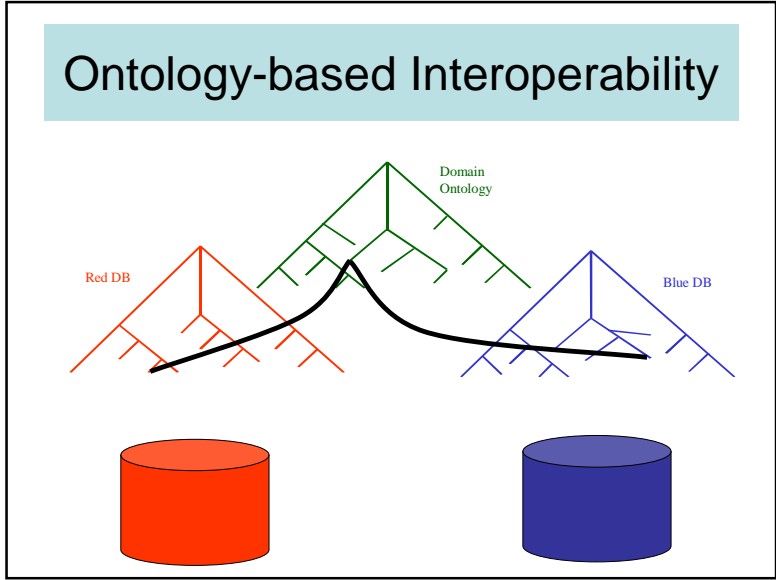


Yes, we do have the road file!

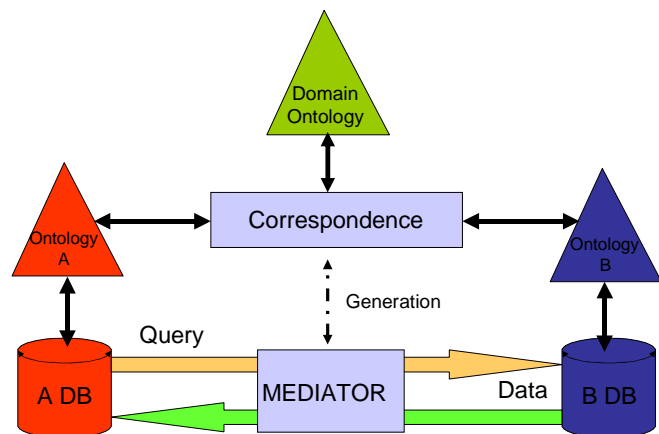
	Sanitation	Postmen	Electricity Co.
Private streets	No	Yes	??
Public streets	Yes	Yes	Generally yes
Street with electricity	?	?	Yes
Street without electricity	?	?	No
	234	251	241



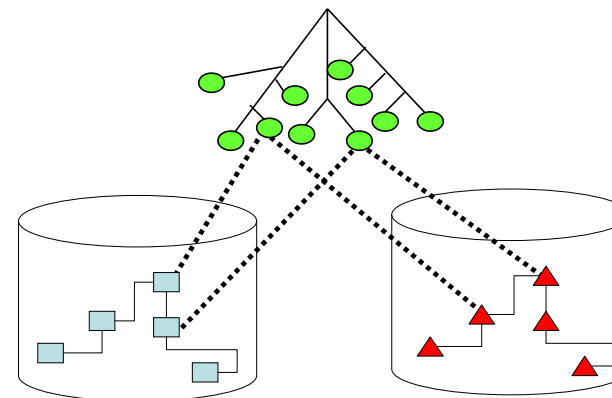
- ### Interoperability
- Discrepancies in data modeling
 - Syntactic level
 - Data structures
 - OpenGIS
 - Semantic level
 - Discrepancies in representations
 - Linguistic problems
 - Ontology



Correspondence with mediators



Example in demography



Example of mediators (1)

- DB Content :
 - DB1 : 1 entity « residents »
 - DB2 : 2 entities « men » and « women »
- How to get
 - DB1 : Men and women?
 - DB2 : Residents?

Example of mediators (2)

- Solution: with mediators
- Exact mediators
 - $DB2.residents = DB2.men + DB2.women$
- Approximate mediators
 - $DB1.men = 0.48 \times DB1.residents$
 - $DB1.women = 0.52 \times DB1.residents$

3 – Why different!

- Chemistry:
 - Vocabulary is stabilized
 - Ex. Definition of Aluminum Oxide: Al_2O_3
 - Same definitions in different languages
 - No (few) conflicts regarding definition
- Urban planning
 - Each actor has his own definition
 - Ex. What is a city?

Example in Chemistry

- Molecule::Root.
- Reaction::Root.
- Ion::Molecule.
- Anion::Ion.
- Cation::Ion.
- AlkaliMetalCation::Cation.
- AlkalineEarthMetalCation::Cation.
- PrecipitationReaction::Reaction.
- GaseousReaction::Reaction.

Definition of “city”

- Answer.com

city (sɪˈti) 
n., pl. -ies.

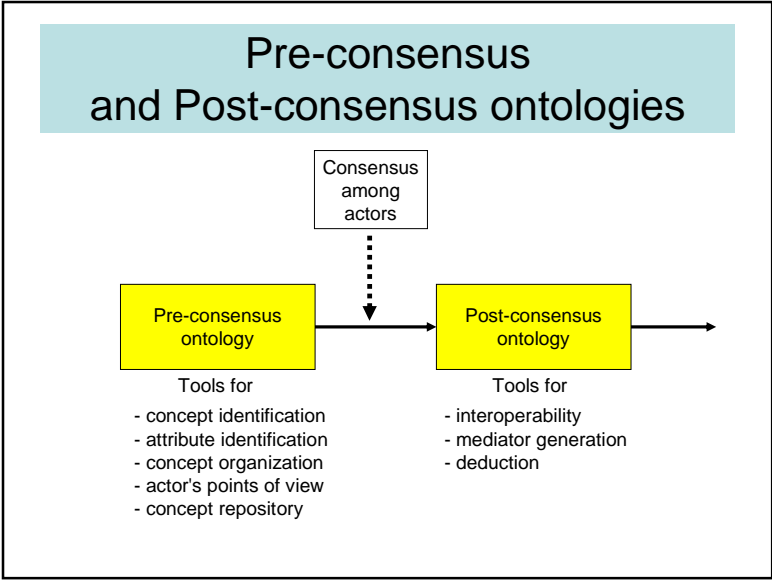
1. A center of population, commerce, and culture; a town of significant size and importance.
2.
 - a. An incorporated municipality in the United States with definite boundaries and legal powers set forth in a charter granted by the state.
 - b. A Canadian municipality of high rank, usually determined by population but varying by province.
 - c. A large incorporated town in Great Britain, usually the seat of a bishop, with its title conferred by the Crown.
3. The inhabitants of a city considered as a group.

- Word Tutor

IN BRIEF: A center of population, commerce, and culture; a town of significant size and importance.

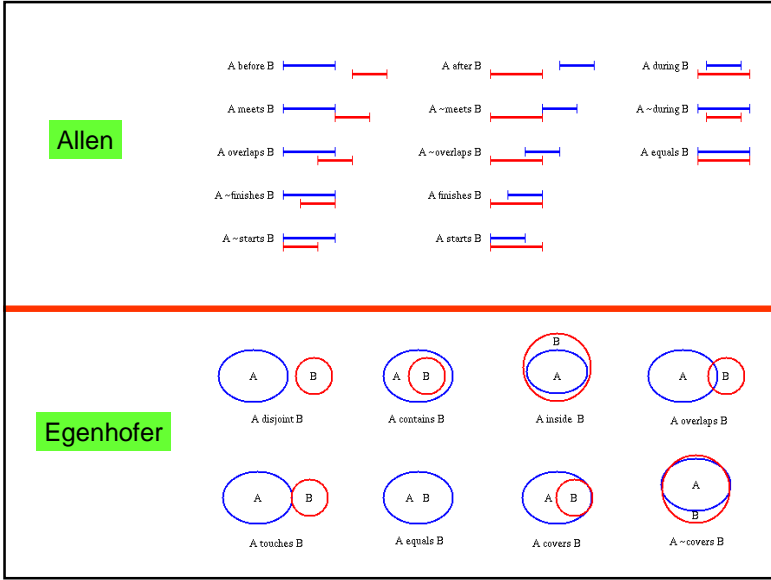
Consequences

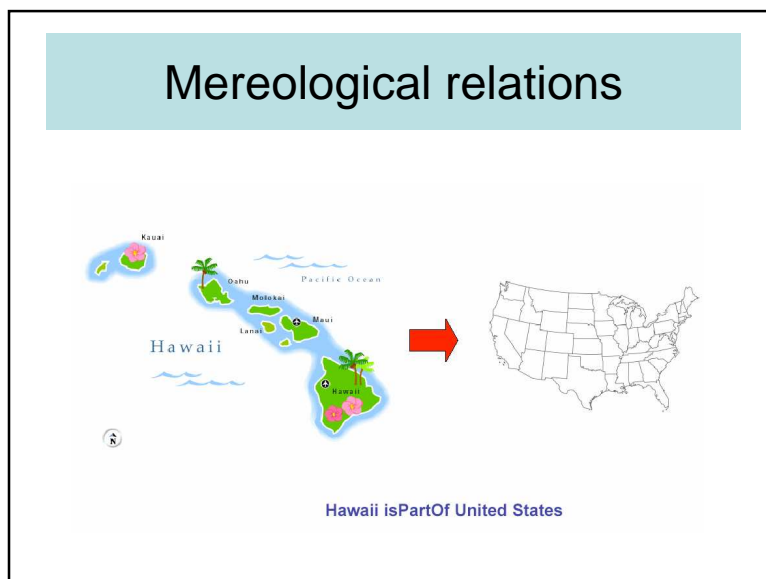
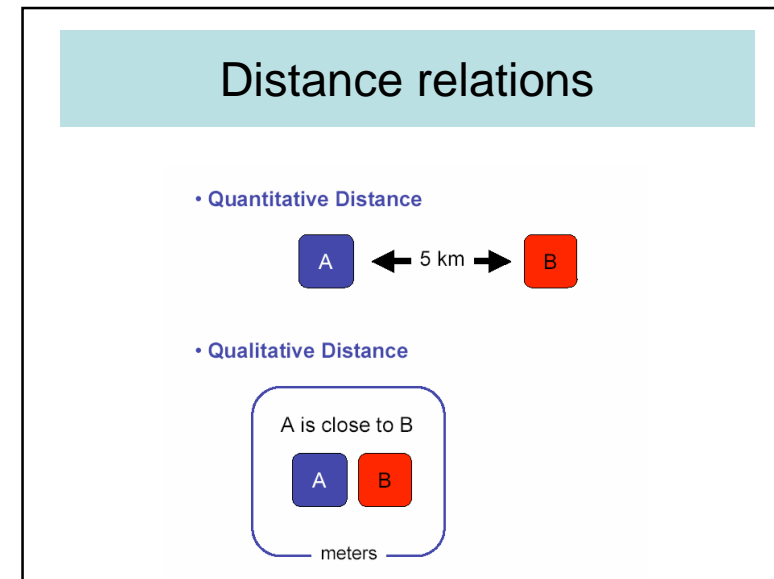
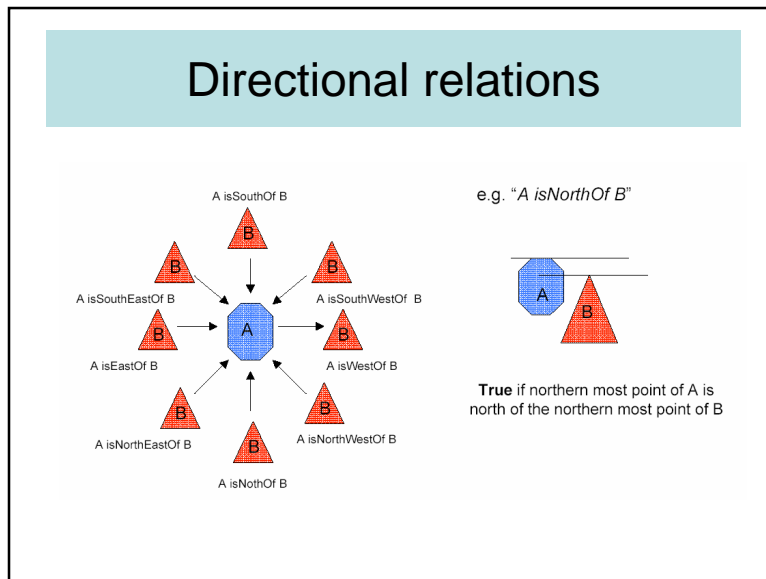
- Necessity of tools for
 - Collecting definitions
 - Comparing them
 - Synthesize them into a unique definition
- Problems:
 - Languages, culture, climate
 - Alphabetic/Multimedia
 - Human interfaces



- ### 4 – Towards Ontologies for Time and Space
- What is time?
 - History
 - Geology
 - Einstein
 - What is space?
 - 0D, 1D, 2D, 3D, 3D+T
 - Toponyms
 - Divisions of space

- ### Theoretical Bases of Spatial Ontologies
- Spatial objects
 - classes
 - description
 - Spatial Relations
 - topological
 - directional
 - distance
 - mereological





Formal Ontological Analysis

- Theory of Parts
- Theory of Wholes
- Theory of Essence and Identity
- Theory of Dependence
- Theory of Qualities
- Theory of Composition and Constitution
- Theory of Participation
- Theory of Representation

A common ontology vocabulary should be based on these theories!!

5 – My own vision of TOWNTOLOGY(1/3)

- Cover the whole urban field, each part assigned to a laboratory
- Find a consensus for each definition
- Create tool to reach the consensus
- Develop in parallel several sub-ontologies referring each other
- Check consistency
- Consolidate the various sub-ontologies
- Check completeness

My own vision of TOWNTOLOGY(2/3)

- Take multiplicity of languages into account
- Take legislative context into account
- Study encoding languages such as OWL, Descriptive Logics, etc.
- Encode

My own vision of TOWNTOLOGY(3/3)

- Select two or three prototypic urban applications for interoperability and/or cooperation
 - Write local ontologies
 - Write mediators
 - Run applications
 - Complete the ontology if necessary

