Some Comments on Ontology for 3D city models

Andrew U. Frank
Geoinformation
TU Vienna
frank@geoinfo.tuwien.ac.at
www.geoinfo.tuwien.ac.at

Overview

1. Why ontology?
2. What is ontology?
3. Different forms of 'exist': a tiered ontology
    - 3.1 Point observations
    - 3.2 Physical objects
    - 3.3 Social constructions
4. Conclusions

Why Ontology

Understanding the semantics (i.e. the meaning) of data is a precondition for data exchange and interoperability.

Other uses of ontology:

- Understanding and communicating data quality
- Producing Graphical User Interfaces automatically

What is an ontology?

An ontology in information science is a "formal, explicit specification of a shared conceptualization".

- What part of reality is considered?
- How is it structured?

Tiered Ontology

Tier 0: Real World

Tier 1: Point-observations

Tier 2: Physical objects

Tier 3: Social constructions

Tier 1: Observations of physical properties in points

- Theory: v = o (x,y,z,t)
  - Examples: RS, photography, eyes
- Real:
  - Random effects
  - Support (instant field of vision)

Every data set has a scale, originating in the observation.

Tier 2: Physical Objects

Objects are product of conceptualization

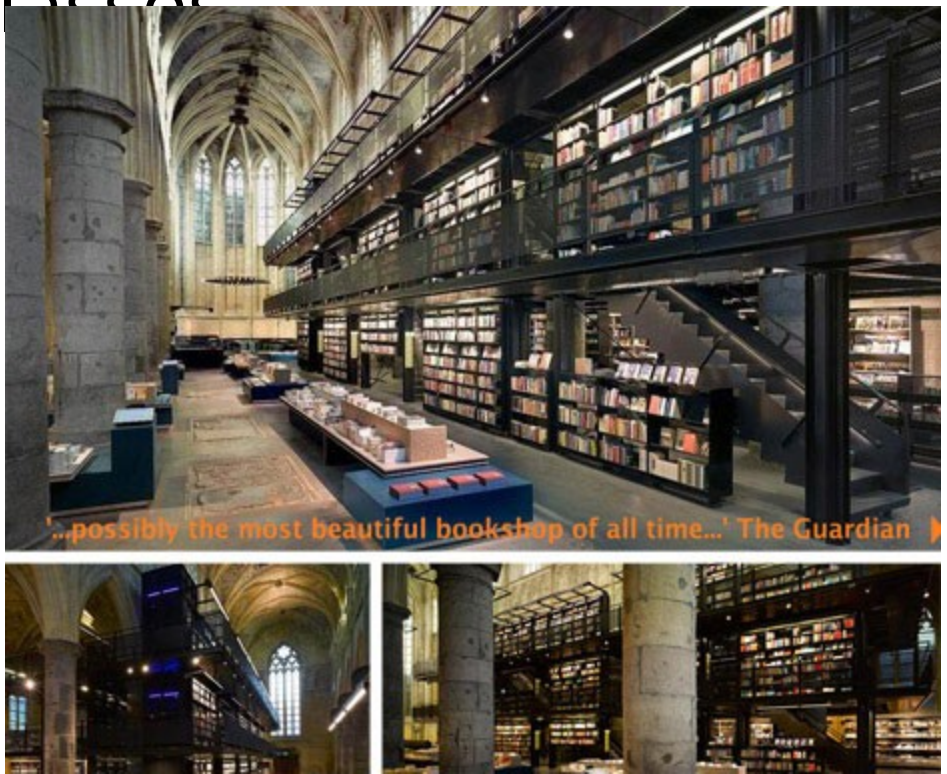
- Prototype: small, movable
- City models:
  - Fixed (month$^{-1)}$
  - Level of detail

Classification of objects

- Typical: hierarchical taxonomy

  How to classify a church converted to a bookstore?

- Better combine distinctions to form a lattice of classes



Tier 3: Social construction

- X counts as Y in context Z

  Example:

  - A piece of metal counts as 1 Euro in Euroland

Values have no error!

Temporal Data

Time and evolution in time is crucial

- State and operations to connect states
- Operations can be modeled at each tier:
  - Tier 1: Partial differential equations
  - Tier 2: physical operations (move..)
  - Tier 3: social operations (to marry)

Connections between tiers

Example:

- Public transportation:
  - Physical moves
  - Payment, business...

Very simple mathematical theory for combination of (algebraic) ontologies

Open Questions:

- Object formation, classification and social construction are all in some form context dependent.
- Same type of context?
- How to transform between contexts.
- Operations and temporal data
- Subdivisions and level of detail
- Data quality measures

We also do geometry: dimension independent models for geometry

- Avoid approximation of coordinate computations by using big integers
- Use convex polytopes as primitives
- Recursive, incremental level of detail, construction of regions

Conclusions

- Data have scale from observation method
- Describe physical properties and simple objects before interpretations and social constructs
- Use a lattice (not a hierarchy) for classification and taxonomy