
Ontologies I

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Overview

- Definition of ontology
 - Perspectives on ontologies
 - Ontologies for the Semantic Web
 - Design and development of ontologies – methods and tools
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What is an ontology?

In practice...

- Simple concept hierarchies
 - Semantic nets
 - Frame systems
 - Logical models
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What is an ontology?

In theory...

*"An ontology is a formal, explicit
specification of a shared conceptualisation."*

(Gruber, 1993)

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What is an ontology?

In English...

An ontology provide a shared vocabulary, which can be used to model a domain, that is, the type of objects and/or concepts that exist, and their properties and relations

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Types of ontologies

From general to specific

- Generic
 - Core
 - Domain
 - Task
 - Application
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The anatomy of ontologies

- Terms
- Definitions of terms
- Axioms
- (Inference mechanisms)

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Perspectives

- Philosophy
- Library and Information Science
- Artificial Intelligence
- Natural Language Processing
- The Semantic Web

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Philosophy

- Objectives
 - Describe world, classify and categorise
- Examples
 - Aristotle, ..., Sowa

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Library & Information Science (LIS)

- Objectives
 - Organise the bibliographic universe
 - Model universal & domain knowledge
- Usage
 - Provide accesspoints to bibliographic entities
 - Collocation device
- Examples
 - Dublin Core, MARC
 - LCC, UDC, SAB

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Artificial Intelligence

- Objectives
 - Model common sense and domain knowledge
- Usage
 - Knowledge representation and reasoning
- Examples
 - CYC, ...

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Natural Language Processing

- Objectives
 - Model lexical and domain knowledge
- Usage
 - Machine Translation, Information Extraction, Q/A
- Examples
 - Wordnet, Generalised Upper Model, Dahlgren

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The Semantic Web

- Objectives
 - Provide semantics for web resources
- Usage
 - Describe resources
...and their contents
- Examples
 - DC, DAML-library, ...

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The Ontology Web Language - OWL

Goal

- Formally describe the semantics of classes and properties used in web documents.
- Go beyond the basic semantics in RDFS

Current status:

- *use cases* and their requirements on ontologies
- eight *design goals*
- 19 *requirements*
- ...and some *objectives*

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Design goals

- Shared ontologies
- Ontology evolution
- Ontology interoperability
- Inconsistency detection
- Balance of expressivity and scalability
- Ease of use
- XML syntax
- Internationalisation

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Requirements

- Ontologies as distinct objects
- Unambiguous term referencing with URIs
- Explicit ontology extension
- Commitment to ontologies
- Ontology metadata
- Versioning information
- Class definition primitives
- Property definition primitives

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Requirements, cont.

- Datatypes
- Class and property equivalence
- Individual equivalence
- Local unique names assumption
- Attaching information to statements
- Classes as instances
- Complex data types
- Cardinality constraints

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Requirements, cont.

- User-displayable labels
- Supporting a character model
- Supporting a uniqueness of Unicode strings

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Design and development

- Design guidelines and principles
 - Guarino, Gruber,...
- Methods
 - Methontology, TOVE,...
- Tools
 - Protégé, KAON,...
- Libraries
 - Ontolingua server, DAML-library,...

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Design and development approaches

- Inspirational
- Inductive
- Deductive
- Synthetic
- Collaborative

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General development methodology

- Specify purpose and scope
- Capture, define, organise
- Formalise, implement
- Integrate existing resources
- Evaluate

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Ontology learning

- ML and NLP techniques to facilitate capture and organisation
- Extend/Refine existing ontology
- Free or semi-structured text as source

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Text-To-Onto (OntoEdit)

- Import and Reuse
- Extract
 - Lexical entry and concept extraction
 - Hierarchical concept clustering
 - Dictionary parsing
 - Association rules
- Prune
- Refine

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Dublin Core

Goals

- Provides a semantic vocabulary for describing the "core" information properties of resources (electronic and "real" physical objects)
- Provide enough information to enable intelligent resource discovery systems

History

- A collaborative effort started in 1995
- Initiated by people from computer science, librarianship, online information services, abstracting and indexing, imaging and geospatial data, museum and archive control.

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Dublin Core - 15 Elements

15 Elements related to a resource:

- Content
 - Title, Subject, Description, Type, Source, Relation and Coverage
- Intellectual property
 - Creator, Publisher, Contributor, Rights
- Instantiation
 - Date, Language, Format, Identifier

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DC - Classes of qualifiers

Two broad classes of qualifiers:

- Element Refinement
 - "...make the meaning of an element narrower or more specific."
 - HTML example from "www.kb.se":
<META NAME="DC.Date.Modified" CONTENT="1999-06-02">
- Encoding Schema
 - "...identify schemas that aid in the interpretation of an element value."
 - HTML example from "www.kb.se":
<META NAME="DC.Subject" SCHEME="SAB" CONTENT="Nationalbibliotek">

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Questions and Research directions

Design & development:

- Consensus / Collaborative v.s. Individual
- Level of granularity

Control & use:

- Centralised v.s. distributed
- Interoperability

The OWL objectives

- Layering, Commitment to portions of ontologies
- Default values, CWA, Procedural attachment
- ...

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