

Organizing knowledge in Semantic Web

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Outline

- 1 Knowledge Organization Systems for Semantic Web
 - Knowledge Organization Systems
 - Basics
 - Types of KOS
 - SKOS



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Knowledge Organization Systems for Semantic Web



Knowledge Organization Systems

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Why do we need to organize knowledge ?

- Indexing
- Retrieval
- Organization and navigation



Basics

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About KOS

KOS = Knowledge Organization Systems

- a generic term used to cover all types of schemes for organizing information and promoting knowledge management
- includes following subtypes [2] :
 - **Term lists** (authority files, glossaries, dictionaries, gazetteers)
 - **Classification and categories** (subject headings, classification schemes, taxonomies, categorization schemes)
 - **Relationship lists** (thesauri, semantic networks, ontologies)
- another classification [1] defines **Controlled vocabularies** which include all types of KOS except of highly structured semantic networks and ontologies



Types of KOS

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What is Controlled vocabulary ?

- **Controlled vocabulary** in its simplest form is a restricted list of words or terms for some specialized purpose
- it is mostly used for descriptive cataloging, tagging or indexing
- "controlled" is used because
 - only terms from the list may be used for the subject area covered
 - only under certain specific conditions may controlled vocabulary change and grow which is responsibility of controlled vocabulary editor, not user



Term lists – Authority file

- **Authority file** is a list of terms that are used to control the variant names for an entity or the domain value for a particular field (names for countries, individuals, and organizations)
- properties
 - might include non/preferred terms
 - generally does not include deep organization or complex structure
- examples
 - the Library of Congress Name Authority File
 - the Getty Geographic Authority File



Term lists – Glossary

- **Glossary** is a list of terms, usually with definitions
- properties
 - the terms may be from a specific subject field or from a particular work
 - the terms are defined within a specific environment and rarely include variant meanings
- examples
 - the Environmental Protection Agency (EPA) Terms of the Environment



Term lists – Dictionary

- **Dictionary** is an alphabetical list of words and their definitions
- properties
 - might include variant senses where applicable
 - more general in scope than glossary
 - might provide synonyms and related words (through the definitions) but it is not explicitly structured or grouped by concept



Term lists – Gazetteer

- **Gazetteer** is a list of place names
- properties
 - each entry may also be identified by feature type (e.g. river, city, or school)
 - geospatially referenced gazetteer provides coordinates for locating the place
- examples
 - the U.S. Code of Geographic Names



Classification and categories – Subject Heading

- **Subject Heading** is a scheme type providing a list of controlled terms to represent the subjects of items in a collection
- properties
 - the list of terms can be extensive and cover a broad range of subjects
 - the list's structure is generally very shallow
- examples
 - the Medical Subject Headings (MeSH)
 - the Library of Congress Subject Headings (LCSH)

Title:	Anti-doping : the fight against <i>performance-enhancing drugs</i> in sport / [European Commission, Directorate-General for Research].
Publisher:	Luxembourg : Office for Official Publications of the European Communities, [2001?]
Description:	1 sheet (folded) : col. ill. ; 21 cm.
Series:	European research in action
Portion of title:	Fight against <i>performance-enhancing drugs</i> in sport
Notes:	Cover title. "KI-38-01-601-EN-D."
OCLC:	(OCoLC)ocm48580907
Subjects:	Athletes--Drug use. Doping in sports.
Other:	European Commission. Directorate-General for Research.

Example of LCSH for performance enhancing drugs (see "Athletes-Drug" and "Doping in sports") taken from <http://http://madcat.library.wisc.edu/>



Classification and categories – Taxonomy

- **Taxonomy** is collection of terms organized into a hierarchical structure
- properties
 - each term in a taxonomy is in one or more parent-child relationships to other terms in the taxonomy
 - parent-child relationship in a taxonomy can have different parent-child relationships in a taxonomy (e.g., whole-part, genus-species, type-instance)
 - generally each parent-child relationships have a single parent of the same type (otherwise it is called poly-hierarchy)
 - traditional taxonomies use "is a kind of" relationship

Note

- the term "taxonomy" is sometimes used in broader sense to refer any means of organizing concepts of knowledge. To limit it to hierarchical structure within this context term "hierarchical taxonomy" is used.
- we will use this narrower sense when talking about taxonomies.

Relationship lists – Thesaurus

- **Thesaurus** is a list of controlled terms and relationships among them. The terms are organized in groups of synonyms representing concepts.
- properties
 - relationships commonly found in thesaurus include hierarchy (broader/narrower term), equivalence (synonym), and association or relatedness (related term).
 - dictionary-thesaurus includes all the associated terms that can be potentially used in place of term entry in various contexts
 - information retrieval thesaurus on the other hand is used in all contexts within covered domain of interest

ABSORPTION

The retention and conversion into another form of energy of rays, waves, or particles by a substance.

UF ABSORPTIVE PROPERTIES

BT **SORPTION**

NT **BIOLOGICAL ABSORPTION**

RESONANCE ABSORPTION

TWO PHOTON ABSORPTION

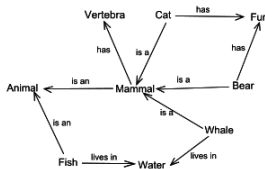
X RAY ABSORPTION ANALYSIS

Representation of term "absorption" taken from DTIC Thesaurus



Relationship lists – Semantic network

- **Semantic network** is organization of terms and concepts in a structure not as hierarchy but as a network (web)
- properties
 - the concepts are represented as nodes of the network while relationships are edges that connects them
 - the relationships are generally richer than in thesaurus. They may include specific whole-part, cause-effect, or parent-child relationships.
- examples
 - Princeton University's WordNet



Example of simple semantic network about Mammals taken from
http://en.wikipedia.org/wiki/Semantic_network



Relationship lists – Ontology

- **Ontology** is structural framework for organizing knowledge that uses controlled vocabulary expressed in an ontology representation language
- properties
 - the language has a grammar for using vocabulary terms to express something meaningful within a specified domain of interest
 - the grammar specifies formal constraints on how terms in the ontology's controlled vocabulary can be used together
 - concepts and relations are organized into "is kind of" hierarchies
 - compared to semantic network it can has axioms and rules
- examples
 - Descriptive Ontology for Linguistic and Cognitive Engineering
 - Basic Formal Ontology

Note

By the term "ontology" we refer here mainly to "formal ontology", i.e. ontology with main purpose to negotiate meaning.

Various types of KOS

Zeng 2008 p.161

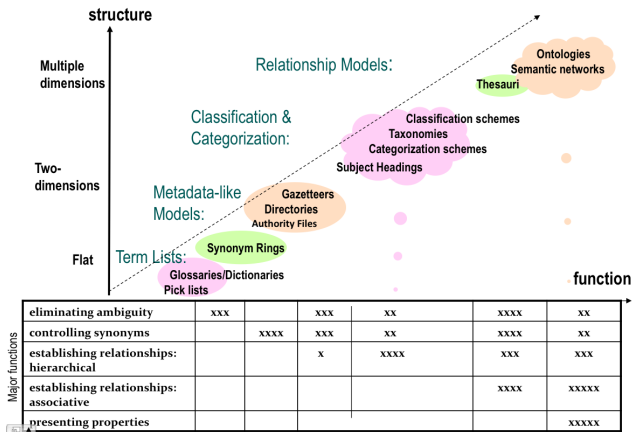


Figure taken from [3] visualize types of KOS, arranged according to the degree of controls introduced (from natural language to controlled language) and the strength of their semantic structure (from weakly structured to strongly structured), corresponding to the major functions of KOS.



SKOS

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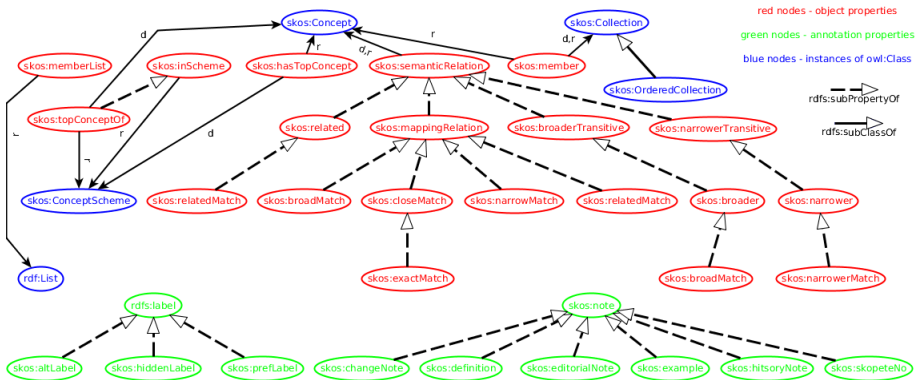
What is SKOS ?

SKOS = **S**imple **K**nowledge **O**rganization **S**ystems

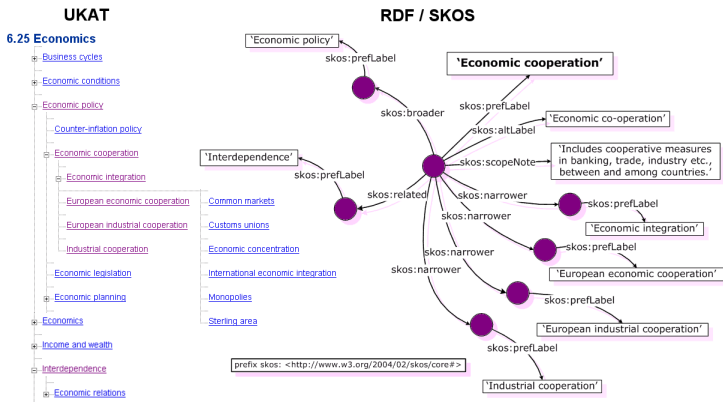
- knowledge organization system that become official W3C recommendation in August 2009
- it allows to express thesauri, classification systems, subject headings, lists ..
- it represent KOS in RDF in simple way
- SKOS data model is formally defined as an OWL Full ontology



Partial SKOS Model – Axiomatic Triples



Example of SKOS representing thesaurus



Portion of UK Archival Thesaurus (UKAT) and its relevant representation in SKOS taken from <http://www.mkbergman.com/374/an-intrepid-guide-to-ontologies/>.



SKOS relevant materials

- SKOS homepage
<http://www.w3.org/2004/02/skos/>
- SKOS Primer
<http://www.w3.org/TR/skos-primer/>
- SKOS Reference
<http://www.w3.org/TR/skos-reference/>
- SKOS Use Cases and Requirements
<http://www.w3.org/TR/2009/NOTE-skos-ucr-20090818/>



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Systems of Knowledge Organization for Digital Libraries: Beyond Traditional Authority Files.
ERIC, 2000.
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- [4] R. Mizoguchi.
Part 1: introduction to ontological engineering.
New Generation Computing, 21(4):365–384, 2003.

