





SKOS Simple Knowledge Organization System

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Learning objective



• Learn SKOS standard for representing simple KOSs, such as thesauri and classifications, as domain specific ontologies





Terminology: Vocabularies vs. Ontologies



Term "Vocabulary" is often used in two meanings

1. Vocabulary = metadata model, by which a particular domain can be represented

- RDF Schema
- Dublin Core
- SKOS standard
- 2. Vocabulary = a particular Knowledge Organization System (KOS) for representing concepts of an application domain, such as a thesaurus
- "Vocabularies" are created using "vocabularies"?

Both (1) and (2) are often called "ontologies"

To disambiguate meanings, I will use term "domain ontology" to refer to KOSs

- Keyword thesauri
- Place gazetteers
- Authority file systems (for persons, organizations)



SKOS Standard: An Introduction





Semantic Web Standards of W3C for Representing Ontologies



- RDF Schema
 - Class hierarchies, property hierarchies, instances, constraints
- SKOS Simple Knowledge Organization System
 - for representing simple domain ontologies
- OWL Web Ontology Language
 - for ontologies with richer semantics





SKOS Overview



- RDF-based standard vocabulary for representing KOSs as ontologies:
 - thesauri, classification schemes, subject heading systems , taxonomies etc.
- Focus: represent KOS structures rather than real world knowledge
 - In SKOS: entries, e.g., "table" are instances of skos:Concept
 - In RDF(S): entries, e.g., "table" are classes of from which actual instances (of tables) are created
- SKOS can be extended using RDF(S) and OWL

Major Domain Ontology Types

General concepts

- Used, e.g., as subject keywords, representing object types
- E.g., chair, studying, philosophy, ...

Actors

- Persons, groups, and organizations
- Individuals with rich metadata
- E.g., Napoleon I, impressionists, Nokia Corp.

Places

- Points, paths, areas with geolocation
- Individuals with rich metadata
- Senate Square, Ring II, Finland

Times

Events

- Birth of Jesus, World War II
- Events are "semantic glue" thank link domain ontologies: actors, places, and times







SKOS vocabulary specification



W3C°

SKOS Simple Knowledge Organization System Reference

W3C Recommendation 18 August 2009

This version:

http://www.w3.org/TR/2009/REC-skos-reference-20090818/

Latest version:

http://www.w3.org/TR/skos-reference

Previous versions:

http://www.w3.org/TR/2009/PR-skos-reference-20090615/

Editors:

<u>Alistair Miles</u>, STFC Rutherford Appleton Laboratory / University of Oxford <u>Sean Bechhofer</u>, University of Manchester

Please refer to the errata for this document, which may include some normative corrections.

See also translations.

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In SKOS Ontologies are Concept Schemes



Ontologies are instances of concept schemes

- Top concepts are pointed out
- ex:animalThesaurus rdf:type skos:ConceptScheme ; dct:title "Simple animal thesaurus" ; dct:creator ex:antoineIsaac ; skos:hasTopConcept ex:mammals ; skos:hasTopConcept ex:fish .

dct: <http://purl.org/dc/terms/> (Dublin Core terms)

Concepts and Labels

Concepts (for machines)

- Instances of skos:Concept
- ex:animals rdf:type skos:Concept .

Labels (human-readable names of concepts)

- skos:prefLabel, skos:altLabel, skos:hiddenLabel
- For example:
 - ex:animals rdf:type skos:Concept ;

skos:prefLabel "animals"@en ;
skos:altLabel "creatures"@en ;
skos:prefLabel "animaux"@fr ;
skos:altLabel "créatures"@fr .

Documentary Notes



- skos:note
 - skos:scopeNote
 - skos:editorialNote
 - skos:changeNote
 - skos:historyNote
- skos:definition
- skos:example





Semantic Relationships



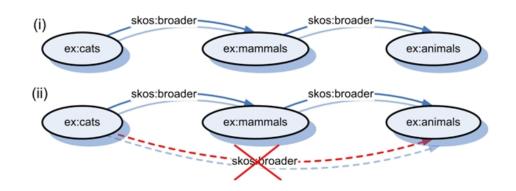
Broader/Narrower relationships

- Like in thesauri
- ex:animals rdf:type skos:Concept ;

skos:prefLabel "animals"@en ;

skos:narrower ex:mammals .

• skos:narrower / skos:broader are *not* transitive!



Example: Thesaurus Limitations for Term Expansion



- Furniture NT Mirrors Mirrors NT Makeup mirrors
- OK, but the results of query "Find all furniture" would contain also makeup mirrors in term expansion!
- Thesaurus hierarchies are not necessarily transitive!



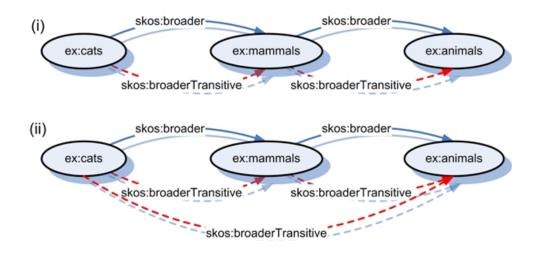


Modeling Transitivity



skos:broaderTransitive and skos:narrowerTransitive

- skos:broader / skos:narrower are their subproperties
- Transitive versions are inferred, not asserted



Other Semantic Relationships



Associative Relationships

 ex:birds rdf:type skos:Concept ; skos:prefLabel "birds"@en ; skos:related ex:ornithology .

skos:broader/narrower/related properties can be refined by introducing more specific properties using rdfs:subPropertyOf

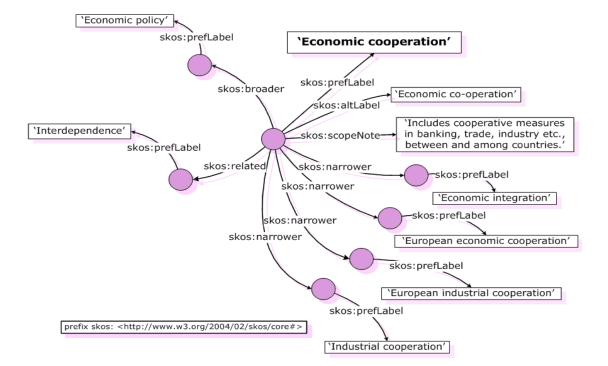
ex:partOf rdfs:subPropertyOf skos:broader .





SKOS Ontology Example





(SKOS Core Guide, 2005)

Mapping Concept Schemes



- Properties for aligning concepts **between different ontologies**
- Equality (between two concept schemes)
 - skos:exactMatch
 - skos:closeMatch
- Other semantic relations (subproperties of concept properties)
 - skos:broadMatch (< skos:broader)
 - skos:narrowMatch (< skos:narrower)
 - skos:relatedMatch (< skos:related)





Other features

skos:Collection

- For grouping concepts by a criterion. Collections are **not** used for indexing and can be blank nodes:
- ex:milk rdf:type skos:Concept ;

skos:prefLabel "milk"@en .

- ex:cowMilk rdf:type skos:Concept ; skos:prefLabel "cow milk"@en ; skos:broader ex:milk .
- ex:goatMilk rdf:type skos:Concept ;

skos:prefLabel "goat milk"@en ;
skos:broader ex:milk .

• _:b0 rdf:type skos:Collection ;

skos:prefLabel "milk by source animal"@en; skos:member ex:cowMilk ; skos:member ex:goatMilk . milk <milk by source animal> cow milk goat milk <milk by fat level>

(van Assem, Isaac, 2005)





Other Features (2)



skos:OrderedCollection (class)

- Same idea as with collections, but members are represented as an ordered list (instance of class rdf:List)
 - Ordering information of subconcepts is often needed in, e.g., user interfaces, and collections do not represent it

skos:notation (property)

- String of characters/code used to uniquely identify a concept within a concept scheme, based on the original KOS identifiers
 - ex:semanticWebCourse skos:notation "CS-E4410" .





SKOS Inference and Validation

SKOS Reference defines also:

- set of axioms for inference for enriching data
 - E.g., reasoning skos:broader/narrowerTransitive triples
- set of integrity conditions for validating SKOS ontologies
 - E.g., the hierarchies should not have loops
 - https://www.w3.org/2001/sw/wiki/SKOS/Validation

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Semantic	SKOS/Validation		
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	The SKOS Raterence@ defines a set of axioms for inference and checking integrity constraints on SKOS. How Group to add rules for checking SKOS data quality, which would apply to some specific domains and application		antic Web Deployment
her W3C resources Authity news Publications Loges, buttons Actuity home page	As a matter of fact, some patterns, which are valid according to the SKOS Core model, are discouraged in spec could not be expressed in the OWL entringy language.	ofic areas of knowledge organization (e.g., these unus or classification). Besides this, some of the axio	tts in the SKOS Reference
	To patilate this, the SKOS community has come with a number of proposals for more complete data validation a	and quality checks. This pages lists some of these:	
	Poolparty consistency checker service # - rules used for consistency checking can be deduced from the qui	ality report upon checking one vocabulary.	
ESS leads hilly revolved IC block	cONDER, now integrated with Poolparty. Rules have been documented in		
Joe coses, case	Christian Mader, Bernhard Masihofer, Antoine Isaac, Finding Quality Issues in 5405 Voca	bularjas.	
nt request IC Member	Proceedings of Theory and Practice of Digital Libraries (TPDL 2012), Springer-Verlag, P paperd	aphos, Cyprus, September 23-27, 2012	
Nubic In Ministriks Fere Relation Changes Special anges Postable version Premaise I Mi Premaise I Mi	later compared/merged with the SKOS ty framework:		
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	Osma Suominer and Eero myvéren: Improving the Quality of SEOS Vocabularies with Should Proceedings of the 18th International Conference on Knowledge Inglineering and Knowledg profi		
	later company/merced with the gSNOS framework #		



SKOS-XL: Extension for Richer Label Modeling

Modeling labels as resources: SKOS-XL

- Labels are instances of skosxl:Label
 - Then labels can have properties, too
- Label instances are referred to using
 - skosxl:prefLabel
 - skosxl:altLabel
 - skosxl:hiddenLabel





SKOS-XL Example



<Love>

skosxl:prefLabel <A> ;
skosxl:altLabel ;
skosxl:hiddenLabel <C> .

```
<A> rdf:type skosxl:Label ;
    skosxl:literalForm "love"@en ;
    dct:created "2006-10-03"^^xsd:date .
```

```
<B> rdf:type skosxl:Label ;
    skosxl:literalForm "adoration"@en ;
    dct:created "2006-10-03"^^xsd:date .
```

```
<C> rdf:type skosxl:Label ;
    skosxl:literalForm "luv"@en ;
    dct:created "2015-05-14"^^xsd:date .
```

More Information



Namespace IRIs of SKOS and SKOS-XL contain the specifications in RDF for 1) classes and 2) properties

- <u>http://www.w3.org/2004/02/skos/core#</u>
 - Direct link to RDF serialization: <u>http://www.w3.org/2004/02/skos/core.rdf</u>
- <u>http://www.w3.org/2008/05/skos-xl#</u>
 - Direct link to RDF serialization: <u>http://www.w3.org/2008/05/skos-xl.rdf</u>

SKOS home page and documentations for a full list of features

For more elaborate ontology modeling there is the <u>OWL standard</u> (topic of the next lecture)





Why Use Ontologies?



- Semantic interoperability based on sharing concepts
- Benefits of reasoning
 - Ontology development
 - Deriving implicit subsumption hierarchies
 - Consistency checking is possible
 - Ontology matching and merging
 - Information retrieval
 - Query expansion
 - Reasoning: finding implicit results based on reasoning
 - Semantic search methods and recommending
 - Using ontology structures to aid query formation and presenting results
 - Semantic analysis of contents













