SKOS - Simple Knowledge Organization System

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Outline

- SKOS Design Goals
- SKOS Vocabulary Definition
- SKOS vs RDFS vs OWL
Definition

«The Simple Knowledge Organization System is a data-sharing standard, bridging several different fields of knowledge, technology and practice.»

In Library Science:

- knowledge organization systems (KOS): tools for organizing large collections of objects
  - E.g., Books or Museum artifacts
- Many different systems are in use today
  - thesauri, classification schemes, subject heading systems, taxonomies, ...
- SKOS models the common and shared aspects of all these systems, focusing on thesauri
Design goals

- Provide a low-cost migration path for porting existing organization systems to the Semantic Web
- Provide a lightweight, intuitive conceptual modeling language for developing and sharing new KOSs
- It can be used on its own, or in combination with more-formal languages such as OWL
- Provides the missing link between the rigorous logical formalism of ontology languages and the chaotic, informal and weakly-structured world of Web-based collaboration tools, as exemplified by social tagging applications
- Based on RDF
General structure

In basic SKOS

- **conceptual resources** (concepts) can be identified with URIs
- **labeled** with lexical strings in one or more natural languages
- **documented** with various types of note
- **semantically related** to each other in informal hierarchies and association networks and
- (**aggregated** into concept schemes).
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- **SKOS Vocabulary Definition**
- SKOS vs RDFS
Concepts

- skos:Concept -> A given resource is a Concept
  - ex:animals rdf:type skos:Concept.
  - Use a URI to represent the resource
  - Use RDF type relationship
Labels

- Label: the expressions that are used to refer to a concept in natural language
- Three different sub-properties of a rdfs:label
  - skos:prefLabel – preferred label
  - skos:altLabel – alternate label(s)
  - skos:hiddenLabel – hidden label(s)
Preferred labels…

- Preferred way to represent the concept
- Used as “descriptor” in indexing systems
- Must be unique
  - Different forms in different languages are possible
- May also be used to unambiguously represent this concept within a KOS and its applications
  - It is recommended that no two concepts in the same KOS be given the same preferred lexical label

```
ex:animals rdf:type skos:Concept;
  skos:prefLabel "animals".
```

```
ex:animals rdf:type skos:Concept;
  skos:prefLabel "animals"@en;
  skos:prefLabel "animaux"@fr.
```
Alternate labels…

- assign an alternative lexical label to a concept
- helpful when assigning labels beyond the one that is preferred for the concept
  - e.g., when synonyms need to be represented
  - E.g., near-synonyms, acronyms, ...

```
ex:animals rdf:type skos:Concept;
    skos:prefLabel "animals"@en;
    skos:altLabel "creatures"@en;
    skos:prefLabel "animaux"@fr;
    skos:altLabel "créatures"@fr.
```

```
ex:fao rdf:type skos:Concept;
    skos:prefLabel "Food and Agriculture Organization"@en;
    skos:altLabel "FAO"@en.
```
Hidden labels...

- The label should be accessible to indexing software, but not otherwise visible
  - e.g., misspelled variants of the preferred label

```turtle
ex:animals rdf:type skos:Concept;
  skos:prefLabel "animaux"@fr;
  skos:altLabel "bêtes"@fr;
  skos:hiddenLabel "betes"@fr.
```
Semantic Relationships

- The meaning of a concept is defined not just by the natural-language words in its labels but also by its links to other concepts in the vocabulary.
- NOTE: “Semantic” here has a different meaning than RDF(S) or OWL Semantics.
- Hierarchical semantic relationships
  - skos:broader, skos:narrower
- Associative (non-hierarchical) relationships
  - skos:related
Hierarchy definition

- `skos:broader` asserts that one concept is broader in meaning (i.e., more general) than another
- `skos:narrower` asserts the inverse, namely when one concept is narrower in meaning (i.e., more specific) than another
- **NOTE:** A broader B reads “A has a broader concept which is B”, not “A is broader than B”

```turtle
ex:animals rdf:type skos:Concept;
   skos:prefLabel "animals"@en;
   skos:narrower ex:mammals.
ex:mammals rdf:type skos:Concept;
   skos:prefLabel "mammals"@en;
   skos:broader ex:animals.
```
What about transitivity?

- The semantics of being “broader” or “narrower” is intuitively transitive
  - A broader B, B broader C intuitively implies that A broader C

- The relationships skos:broader and skos:narrower are **not** defined as transitive properties
  - Repeat: they are **not transitive**

- Why? To avoid unintended effects in “dirty” hierarchies
  - For KOS that are not thesauri
  - Due to the Open-World effect
Example

(i) ex:cats \(\xrightarrow{\text{skos:broader}}\) ex:mammals \(\xrightarrow{\text{skos:broader}}\) ex:animals

(ii) ex:cats \(\xrightarrow{\text{skos:broader}}\) ex:mammals \(\xrightarrow{\text{skos:broader}}\) ex:animals

\[\begin{array}{c}
\text{ex:cats} \\
\text{ex:mammals} \\
\text{ex:animals}
\end{array}\]
The solution?

- Two new properties:
  - skos:broaderTransitive
    - Super-property of skos:broader
    - Transitive property
  - skos:narrowerTransitive
    - Super-property of skos:narrower
    - Transitive property
Example
Reasoning steps

ex:animals skos:prefLabel "animals"@en.
ex:mammals skos:prefLabel "mammals"@en;
   skos:broader ex:animals.
ex:cats skos:prefLabel "cats"@en;
   skos:broader ex:mammals.

ex:cats skos:broaderTransitive ex:mammals.
ex:mammals skos:broaderTransitive ex:animals.

Super-property

Transitivity
Associative relationships

- Two concepts are somewhat related to each other
  - skos:related
  - Symmetric property
  - Non-transitive property
- Semantic warning: skos:related and skos:broaderTransitive must be disjoint, or the universe will collapse

```xml
ex:birds rdf:type skos:Concept;
  skos:prefLabel "birds"@en;
  skos:related ex:ornithology.
ex:ornithology rdf:type skos:Concept;
  skos:prefLabel "ornithology"@en.
```
Documentary notes

- The “formal” part of a KOS is captured by its semantic relationships.
- Human users often need more (textual) information to be associated with concepts.
  - Explanations, definitions, scope notes, usage notes, …
- Additional properties, also inspired by the standards about Thesauri [ISO2788] and Structured Vocabularies [BS8723-2]
Documentary relationships (1/2)

- `skos:scopeNote` supplies some, possibly partial, information about the intended meaning of a concept, especially as an indication of how the use of a concept is limited in indexing practice.
- `skos:definition` supplies a complete explanation of the intended meaning of a concept
- `skos:example` supplies an example of the use of a concept
- `skos:historyNote` describes significant changes to the meaning or the form of a concept
Documentary relationships (2/2)

- skos:editorialNote supplies information that is an aid to administrative housekeeping, such as reminders of editorial work still to be done, or warnings in the event that future editorial changes might be made.
- skos:changeNote documents fine-grained changes to a concept, for the purposes of administration and maintenance.
- All sub-properties of the abstract skos:note.
Examples

ex:microwaveFrequencies skos:scopeNote "Used for frequencies between 1GHz to 300GHz"@en.

ex:documentation skos:definition "the process of storing and retrieving information in all fields of knowledge"@en.

ex:organizationsOfScienceAndCulture skos:example "academies of science, general museums, world fairs"@en.

ex:childAbuse skos:historyNote "estab. 1975; heading was: Cruelty to children [1952-1975]"@en.

ex:doubleclick skos:editorialNote "Review this term after company merger complete"@en.
ex:folksonomy skos:editorialNote "Check spelling with Thomas Vander Wal"@en.

ex:tomato skos:changeNote "Moved from under 'fruits' to under 'vegetables' by Horace Gray"@en.
Notes are multilingual, too

```xml
ex:pineapples rdf:type skos:Concept;
  skos:prefLabel "pineapples"@en;
  skos:prefLabel "ananas"@fr;
  skos:definition "The fruit of plants of the family Bromeliaceae"@en;
  skos:definition "Le fruit d'une plante herbacée de la famille des broméliacées"@fr.
```
Mixing SKOS with other vocabularies

- RDF allows mixing various vocabularies
- E.g., use Dublin Core to predicate about the ownership of a concept definition
  - ex:madagascarFishEagle dct:creator [ foaf:name "John Smith" ].
- E.g., use skos to provide documentation notes to RDF/RDFS concepts or relationships
  - <http://www.w3.org/People/Berners-Lee/card#i> rdf:type foaf:Person;
  - foaf:name "Timothy Berners-Lee";
  - rdfs:label "TBL";
Mixing SKOS with other vocabularies

- E.g., use skos to provide documentation notes to OWL Classes
  - ex:Human rdf:type owl:Class;
  - rdfs:label "human"@en;
  - rdfs:label "man"@en.

- E.g., link online resources to concepts:
  - ex1:platypus rdf:type skos:Concept;
    skos:prefLabel "platypus"@en.
    rdf:type foaf:Document; dct:subject
    ex1:platypus.
References

- SKOS Simple Knowledge Organization System Primer, W3C Working Group Note 18 August 2009
  - http://www.w3.org/TR/skos-primer
- SKOS Simple Knowledge Organization System Reference, W3C Recommendation 18 August 2009
  - http://www.w3.org/TR/skos-reference
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