SKOS: Simple Knowledge Organization System

Unit 6

SKOS

- **Simple Knowledge Organization System**
  - A W3C Recommendation
  - Based on RDF, RDFS, and some OWL, a kind of "RDFS-Plus"
- Provides means for expressing knowledge organization systems (KOS) in a distributed and linkable way for use in a Linked Data and Semantic Web environment
  - Controlled vocabularies, thesauri, taxonomies, classification schemes, subject heading lists, name authorities, etc.
- W3C *SKOS Primer* Introduction extracts:
  - "… designed to provide a low-cost migration path for porting existing organization systems to the Semantic Web."
  - "SKOS can be seen as a bridging technology, providing the missing link between the rigorous logical formalism of ontology languages such as OWL and the chaotic, information and weakly-structured world of Web-based collaboration tools, as exemplified by social tagging applications."

Knowledge organization systems/services (KOS)

- Schemes for organizing information and knowledge
  - Mostly using some kind of vocabulary control
- Connect users to information content via browsing and searching
- Give users an overview of content of a collection, database, or web site
- Multiple ways to accomplish this
- Many different needs in different communities
- Thus: many different KOS and CVs for different communities, users, and information needs

ANSI/NISO Z39.19

- Predominant CV & thesaurus standard in USA
- Provides valuable conceptual framework
- Reflects decades of research and experience
- Take more as general guidelines than absolute rules; judge how best to apply for local situation
- Advantages of staying close to ANSI/NISO:
  - Most thesaurus management software designed to be ANSI/NISO-compliant
  - Interoperability with other databases, corporate mergers → mergers of two databases, etc.

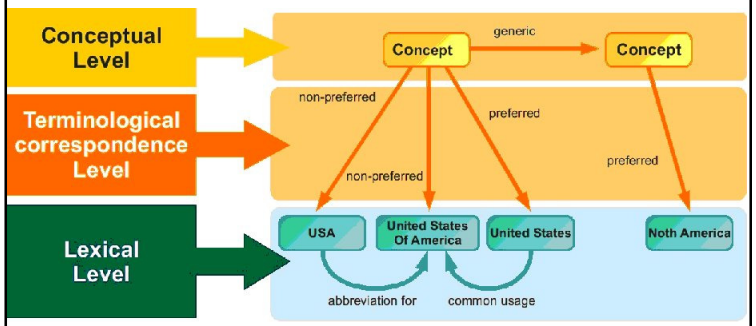
Types of Knowledge Organization Systems (Controlled Vocabularies)

List	Synonym Ring	Authority File	Taxonomy / Classification Scheme	Thesaurus
No semantic relationships	Equivalence relationships	Equivalence relationships	Equivalence relationships Hierarchical relationships	Equivalence relationships Hierarchical relationships Associative relationships
Controlled list of terms; no synonym control	Synonymous terms with no preferred term *Note: used for search engine retrieval, not for indexing*	Controlled list of terms, with synonyms indentified, and one of those terms selected as preferred, the others non-preferred *Note: this is only one of many ways of defining and understanding authority files*	Same as authority file, but with preferred terms arranged into hierarchies of broader and narrower terms *Note: many Web site taxonomies are not formal CVs of this type*	Same as classification scheme, but with associative relationships (related terms) indentified among the preferred terms

Traditional semantic relationships

Relationship	Type Example
Equivalence	
Synonymy	UN / United Nations
Lexical variants	pediatrics / paediatrics
Near synonymy	sea water / salt water
Hierarchical	
Generic (or IsA) (is a kind of)	birds / parrots
Instance (or IsA) (is a specific instance of)	sea / Mediterranean Sea
Whole / Part	brain / brain stem
Associative	
Cause / Effect	accident / injury
Process / Agent	velocity measurement / speedometer
Process / Counter-agent	fire / flame retardant
Action / Product	writing / publication
Action / Property	communication / communication skills
Action / Target	teaching / student
Concept or Object / Property	steel alloy / corrosion resistance
Concept or Object/ Origins	water / well
Concept or Object / Measurement Unit or Mechanism	chronometer / minute
Raw material / Product	grapes / wine
Discipline or Field / Object or Practitioner	neonatology / infant

Organizational levels of a concept-based thesaurus



Source: Pastor-Sanchez, J., Martínez Mendez, F. J., Rodríguez-Muñoz, J. V. 2009. "Advantages of thesaurus representation using the Simple Knowledge Organization System (SKOS) compared with proposed alternatives." *Information Research,* Vol. 14, no. 4 (Dec.). http://informationr.net/ir/14-4/paper422.html

SKOS concepts and concept schemes

Element	Vocabulary	Descriptive Definition
Concept	**skos:Concept**	Instance of owl:class
Concept scheme	**skos:ConceptScheme**	Instance of owl:class Disjoint with skos:Concept
Inclusion into a concept scheme	**skos:inScheme**	Instance of owl:ObjectProperty Domain: skos:Concept Range: skos:ConceptScheme
Top Concept	skos:hasTopConcept	Instance of owl:ObjectProperty Domain: skos:ConceptScheme Range: valores skos:Concept

Source for SKOS tables used in these slides: Pastor-Sanchez, J., Martínez Mendez, F. J., Rodríguez-Muñoz, J. V. 2009. "Advantages of thesaurus representation using the Simple Knowledge Organization System (SKOS) compared with proposed alternatives." *Information Research,* Vol. 14, no. 4 (Dec.).

SKOS lexical labels

Element	Vocabulary	Descriptive Definition
Preferred label	**skos:prefLabel**	Instance of owl:AnnotationProperty Range: rdf:PlainLiteral Domain: any resource A resource has no more than one value of skos:prefLabel per language Pairwise disjoint with skos:altLabel and skos:hiddenLabel
Alternative label	**skos:altLabel**	Instance of owl:AnnotationProperty Range: rdf:PlainLiteral Domain: any resource Pairwise disjoint with skos:prefLabel and skos:hiddenLabel
Hidden label	skos:hiddenLabel	Instance of owl:AnnotationProperty Range: rdf:PlainLiteral Domain: any resource Pairwise disjoint with skos:prefLabel and skos:altLabel

Animal thesaurus example: traditional thesaurus display

cats

UF (used for) *domestic cats*

BT (broader terms) **animals**

RT (related term) **wildcats**

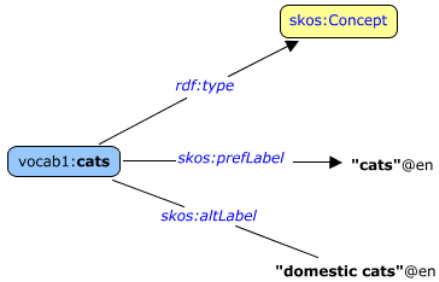
SN (scope note) used only for domestic cats

domestic cats

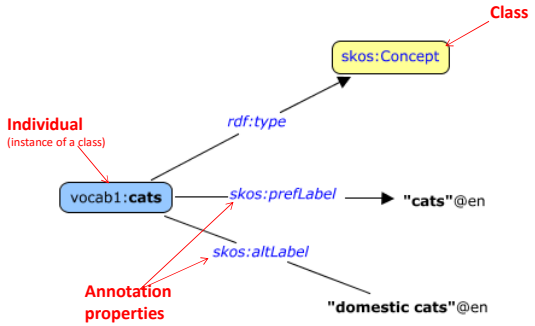
USE cats

This example, here and on the follow slides, is based on: Antoine Isaac, "SKOS Simple Knowledge Organization System," Dublin Core Tutorial, Sept. 21, 2011: http://dublincore.org/resources/training/dc-2011/Tutorial_Isaac.pdf

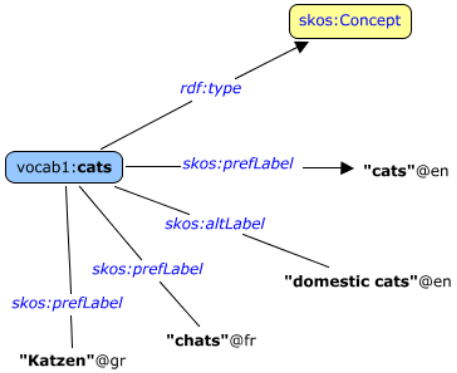
SKOS concept, preferred and alternative labels



SKOS concept, preferred and alternative labels



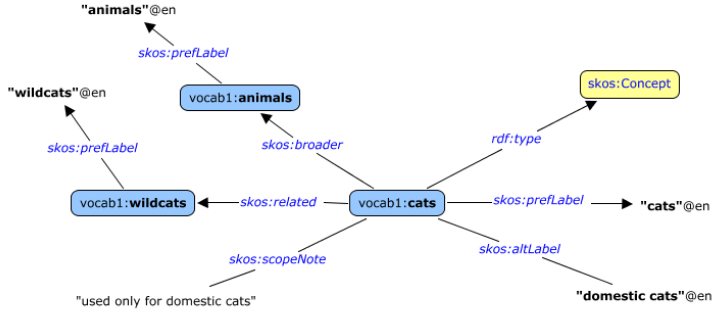
SKOS preferred labels in multiple languages



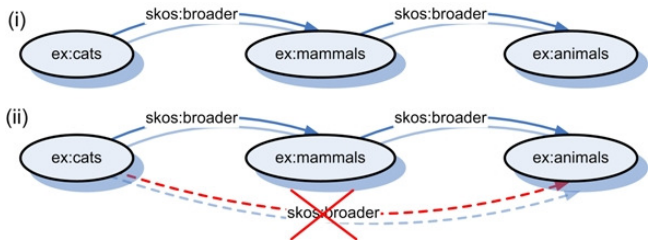
SKOS semantic relationships

Element	Vocabulary	Descriptive Definition
Semantic relationship	skos:semanticRelation	Instance of owl:ObjectProperty Domain: skos:Concept Range: skos:Concept
Broader transitive	skos:broaderTransitive	Instance of owl:ObjectProperty Instance of owl:TransitiveProperty and Sub-property of skos:semanticRelation
Narrower transitive	skos:narrowerTransitive	Instance of owl:ObjectProperty Instance of owl:TransitiveProperty Defined as owl:inverseOf skos:broaderTransitive Sub-property of skos:semanticRelation
Generic broader	**skos:broader**	Instance of owl:ObjectProperty Not instance of owl:TransitiveProperty Sub-property of skos:broaderTransitive
Generic narrower	**skos:narrower**	Instance of owl:ObjectProperty Not instance of owl:TransitiveProperty Defined as owl:inverseOf skos:broader Sub-property of skos:narrowerTransitive
Related	**skos:related**	Instance of owl:ObjectProperty Instance of owl:SymmetricProperty Not instance of owl:TransitiveProperty Sub-property of skos:semanticRelation Disjoint with skos:broaderTransitive

SKOS broader and related terms and scope note

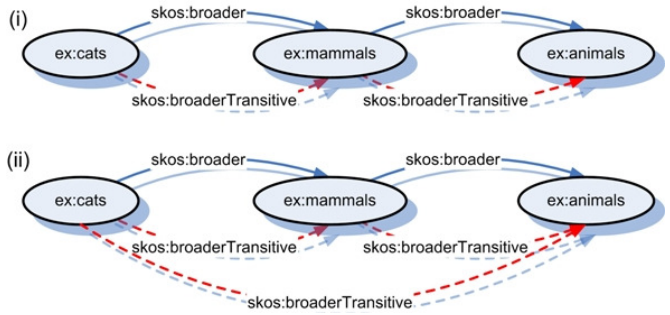


Transitive hierarchies in SKOS



Source: SKOS Primer: https://www.w3.org/TR/skos-primer/

Transitive hierarchies in SKOS



Source: SKOS Primer: https://www.w3.org/TR/skos-primer/

Transitivity:

Subproperties do not inherit the transitivity of their superproperties

Examples:

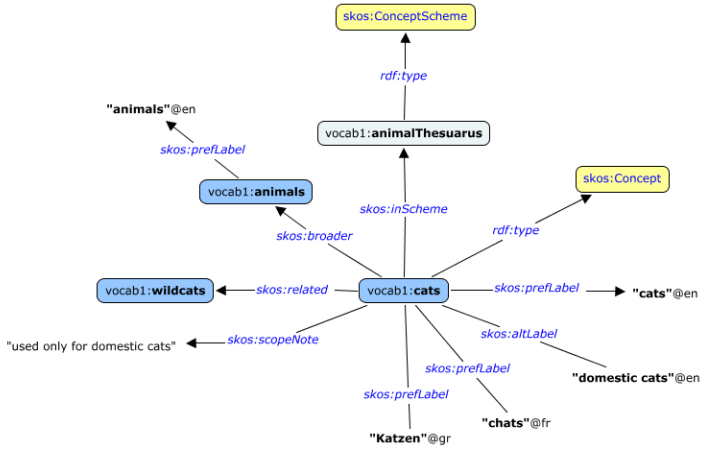
- *isAncestorOf* ← transitive property
  - *isParentOf* ← non transitive property
    - *isMotherOf* ← non transitive property

- *skos:broaderTransitive* ← transitive property
  - *skos:broader* ← non transitive property

SKOS notations and documentation

Element	Vocabulary	Descriptive Definition
Notation	skos:notation	Instance of owl:DatatypeProperty Domain: skos:Concept Range: Typed literal
Note	skos:note	Instance of owl:AnnotationProperty Domain: rdfs:Resource
Scope note	**skos:scopeNote**	Instance of owl:AnnotationProperty Sub-property of skos:note Domain: rdfs:Resource
History note	skos:historyNote	Instance of owl:AnnotationProperty Sub-property of skos:note Domain: rdfs:Resource
Change note	skos:changeNote	Instance of owl:AnnotationProperty Sub-property of skos:note Domain: rdfs:Resource
Definition	skos:definition	Instance of owl:AnnotationProperty Sub-property of skos:note Domain: rdfs:Resource
Editorial note	skos:editorialNote	Instance of owl:AnnotationProperty Sub-property of skos:note Domain: rdfs:Resource
Example	skos:example	Instance of owl:AnnotationProperty Sub-property of skos:note Domain: rdfs:Resource

SKOS concept scheme



SKOS mapping relationships

Element	Vocabulary	Descriptive Definition
Mapping relationship	skos:mappingRelation	Instance of owl:ObjectProperty Domain: skos:Concept Range: skos:Concept
Close match	skos:closeMatch	Instance of owl:ObjectProperty Instance of owl:SymmetricProperty Sub-property of skos:mappingRelation
Exact match	skos:exactMatch	Instance of owl:ObjectProperty Instance of owl:SymmetricProperty Sub-property of skos:mappingRelation
Broad match	skos:broadMatch	Instance of owl:ObjectProperty Sub-property of skos:mappingRelation Sub-property of skos:broader
Narrower match	skos:narrowerMatch	Instance of owl:ObjectProperty Sub-property of skos:mappingRelation Sub-property of skos:narrower Defined as owl:inverseOf skos:broader //identical situation as for skos:narrowerTransitive and skos:narrower//

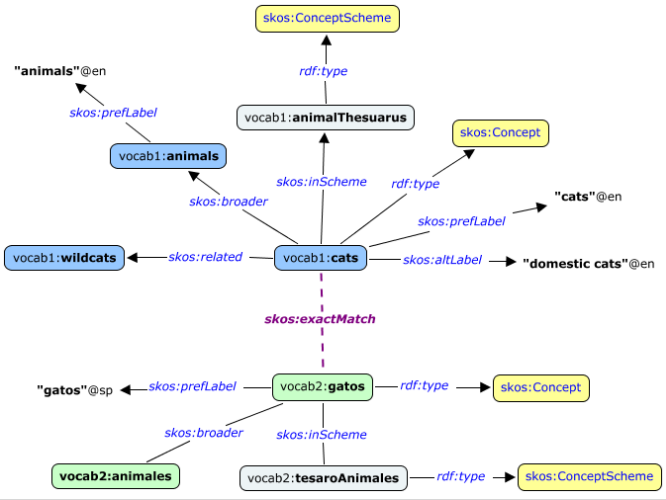
Example from SKOS Primer

ex1:animal **skos:exactMatch** ex2:animals.

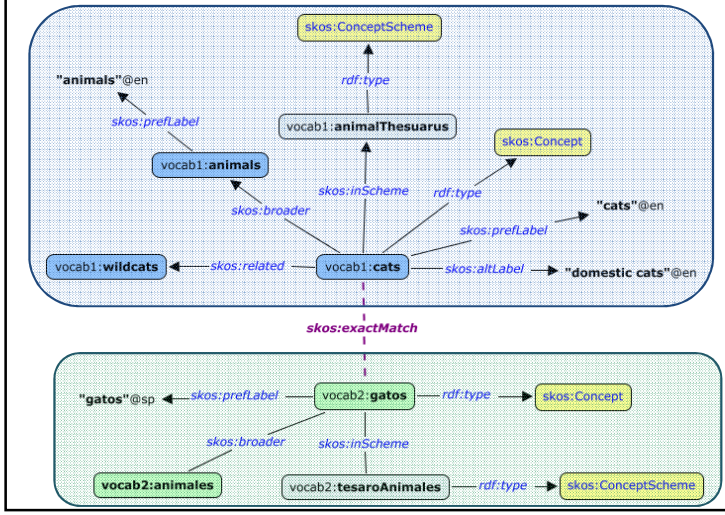
ex1:platypus **skos:relatedMatch** ex2:eggs.

ex1:platypus **skos:broadMatch** ex2:eggLayingAnimals.

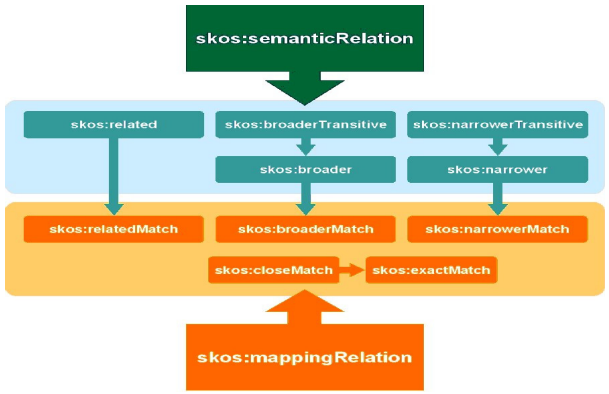
SKOS matching terms among different schemes



SKOS matching terms among different schemes



SKOS semantic relationships



Source: Pastor-Sanchez, J., Martínez Mendez, F. J., Rodríguez-Muñoz, J. V. 2009. "Advantages of thesaurus representation using the Simple Knowledge Organization System (SKOS) compared with proposed alternatives." *Information Research,* Vol. 14, no. 4 (Dec.).

SKOS concept collections

Element	Vocabulary	Descriptive Definition
Collection	skos:Collection	Instance of owl:Class Disjoint with skos:Concept y skos:ConceptScheme
Ordered collection	skos:OrderedCollection	Instance of owl:Class Sub-class of skos:Collection
Member of a collection	skos:member	Instance of owl:ObjectProperty Instance of owl:FunctionalProperty Domain: skos:OrderedCollection Range: rdf:List Allowed more than one value of skos:member
Member of a list	skos:memberList	Instance of owl:ObjectProperty Instance of owl:FunctionalProperty Domain: skos:OrderedCollection Range: rdf:List Allowed more than one value of skos:member

SKOS in Turtle

```
@prefix : <http://www.sjm-animals#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .

:AnimalThesaurus rdf:type skos:ConceptScheme .

:cats rdf:type skos:Concept ;
    skos:prefLabel "cats"@en , "Katzen"@de , "chats"@fr ;
    skos:altLabel "domestic cats"@en ;
    skos:inScheme :AnimalThesaurus ;
    skos:broader :animals ;
    skos:narrower :MaineCoonCats ;
    skos:related :wildcats ;
    skos:scopeNote "used only for domestic cats" .

:animals rdf:type skos:Concept ;
      skos:prefLabel "animals"@en ;
      skos:inScheme :AnimalThesaurus ;
      skos:narrower :cats .

:MaineCoonCats rdf:type skos:Concept ;
        skos:prefLabel "Main Coon cats"@en ;
        skos:inScheme :AnimalThesaurus ;
        skos:broader :cats .

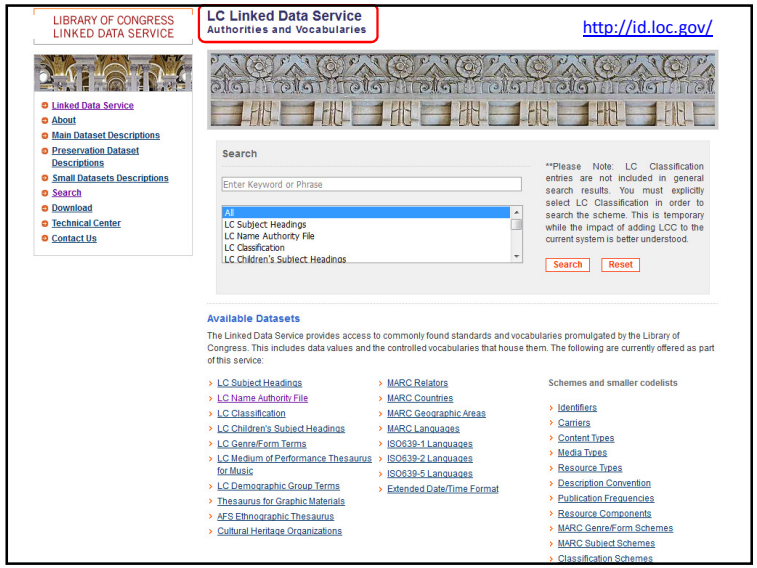
:wildcats rdf:type skos:Concept ;
      skos:prefLabel "wildcats"@en ;
      skos:inScheme :AnimalThesaurus ;
      skos:related :cats .
```

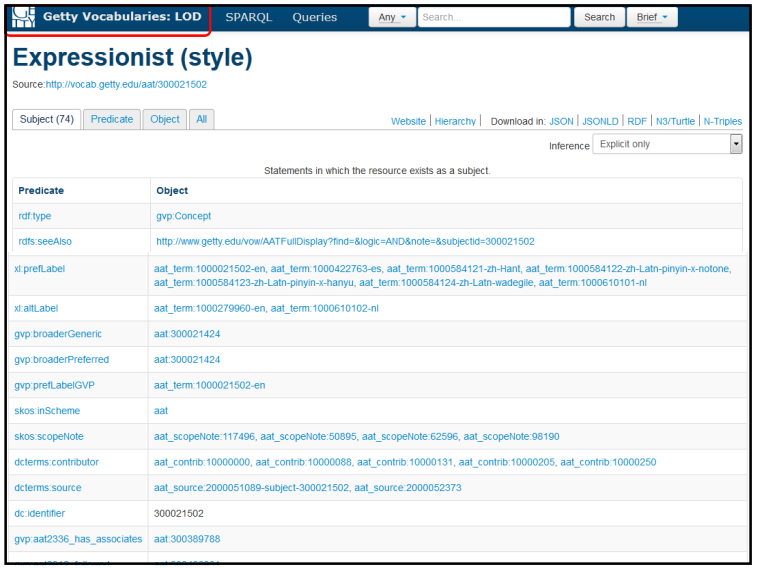
SKOS use cases

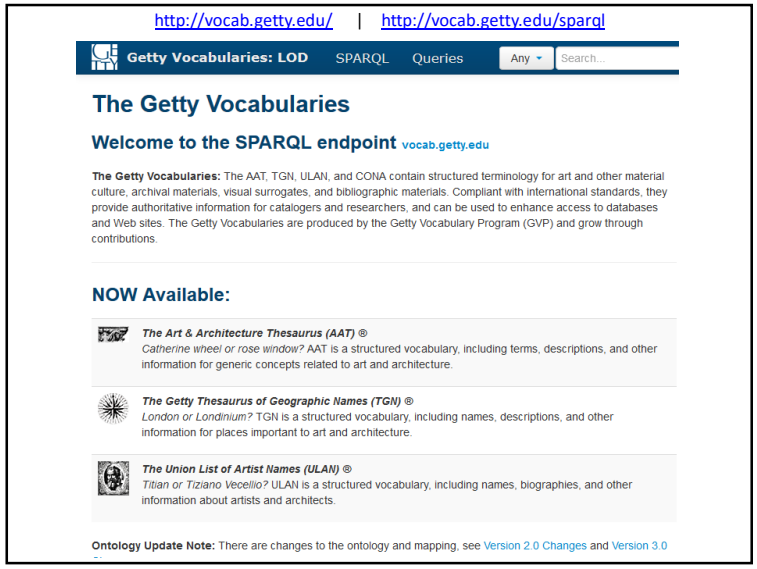
http://www.w3.org/TR/2009/NOTE-skos-ucr-20090818/

1. An integrated view to medieval illuminated manuscripts
2. Bio-zen ontology framework for representing scientific discourse in life science
3. Semantic search service across mapped multilingual thesauri in the agriculture domain
4. Supporting product life cycle
5. CHOICE@CATCH ranking of candidate terms for description of radio and TV programs

… and more …







SKOS Examples

- **NAL: The National Agricultural Library's Agricultural Thesaurus**
  - *Climatic zones*
    - HTML page: Persistent URI: http://lod.nal.usda.gov/nalt/12169 ; see "Record Views"
    - RDF/XML file: http://lod.nal.usda.gov/nalt/12169.rdf
- **LC Linked Data Service: Authorities and Vocabularies: Subjects**
  - *Climatic zones*
    - HTML page URI: http://id.loc.gov/authorities/subjects/sh85027043
    - SKOS - RDF/XML file: http://id.loc.gov/authorities/subjects/sh85027043.skos.rdf
- **VIAF: Virtual International Authority File**
  - *Gándhí, Indira, 1917-1984*
    - HTML page: Permalink: http://viaf.org/viaf/86791938
    - RDF/XML file: http://viaf.org/viaf/86791938/rdf.xml
- **LC Linked Data Service: Authorities and Vocabularies: Names**
  - *Mandela, Nelson, 1918-*
    - HTML page URI: http://id.loc.gov/authorities/names/n85153068.html
    - SKOS - RDF/XML file: http://id.loc.gov/authorities/names/n85153068.skos.rdf

NAL "climatic zones" SKOS record

```
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:skos="http://www.w3.org/TR/2009/REC-skos-reference-20090818/" >
 <rdf:Description rdf:about="http://lod.nal.usda.gov/nalt/12169">
  <skos:altLabel xml:lang="en">climatic areas</skos:altLabel>
  <skos:related rdf:resource="http://lod.nal.usda.gov/nalt/26899"/>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/26898"/>
  <skos:prefLabel xml:lang="es">zonas climáticas</skos:prefLabel>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/12160"/>
  <skos:broader rdf:resource="http://lod.nal.usda.gov/nalt/76121"/>
  <skos:prefLabel xml:lang="en">climatic zones</skos:prefLabel>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/26892"/>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/125276"/>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/26893"/>
  <skos:related rdf:resource="http://lod.nal.usda.gov/nalt/26900"/>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/11923"/>
  <rdf:type rdf:resource="http://www.w3.org/TR/2009/REC-skos-reference-20090818/Concept"/>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/26894"/>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/26896"/>
  <skos:related rdf:resource="http://lod.nal.usda.gov/nalt/17392"/>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/26895"/>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/20512"/>
  <skos:narrower rdf:resource="http://lod.nal.usda.gov/nalt/26897"/>
 </rdf:Description>
</rdf:RDF>
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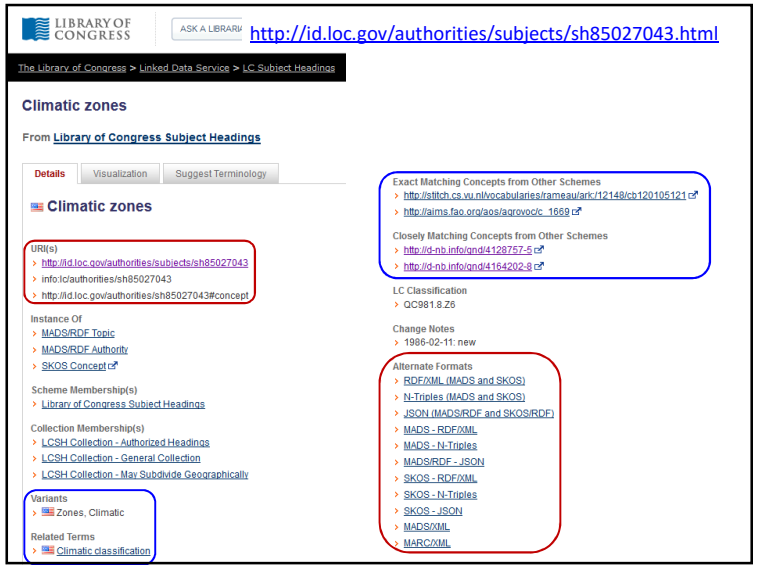

LCSH "Climatic zones" SKOS record

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
<rdf:Description rdf:about="http://id.loc.gov/authorities/subjects/sh85027043">
    <rdf:type rdf:resource="http://www.w3.org/2004/02/skos/core#Concept"/>
    <skos:prefLabel xml:lang="en" xmlns:skos="http://www.w3.org/2004/02/skos/core#">Climatic zones</skos:prefLabel>
    <skosxl:altLabel xmlns:skosxl="http://www.w3.org/2008/05/skos-xl#">
        <rdf:Description>
            <rdf:type rdf:resource="http://www.w3.org/2008/05/skos-xl#Label"/>
            <skosxl:literalForm xml:lang="en">Zones, Climatic</skosxl:literalForm>
        </rdf:Description>
    </skosxl:altLabel>
    <skos:related rdf:resource="http://id.loc.gov/authorities/subjects/sh85027038" xmlns:skos="http://www.w3.org/2004/02/skos/core#"/>
    <skos:exactMatch rdf:resource="http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb120105121"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"/>
    <skos:exactMatch rdf:resource="http://aims.fao.org/aos/agrovoc/c_1669" xmlns:skos="http://www.w3.org/2004/02/skos/core#"/>
    <skos:closeMatch rdf:resource="http://d-nb.info/gnd/4128757-5" xmlns:skos="http://www.w3.org/2004/02/skos/core#"/>
    <skos:closeMatch rdf:resource="http://d-nb.info/gnd/4164202-8" xmlns:skos="http://www.w3.org/2004/02/skos/core#"/>
    <skos:inScheme rdf:resource="http://id.loc.gov/authorities/subjects" xmlns:skos="http://www.w3.org/2004/02/skos/core#"/>
        <skos:altLabel xml:lang="en" xmlns:skos="http://www.w3.org/2004/02/skos/core#">Zones, Climatic</skos:altLabel>
        <skos:changeNote xmlns:skos="http://www.w3.org/2004/02/skos/core#">
            <cs:ChangeSet xmlns:cs="http://purl.org/vocab/changeset/schema#">
                <cs:subjectOfChange rdf:resource="http://id.loc.gov/authorities/subjects/sh85027043"/>
                <cs:creatorName>Library of Congress, Network Development and MARC Standards Office</cs:creatorName>
                <cs:createdDate rdf:datatype="http://www.w3.org/2001/XMLSchema#dateTime">1986-02-11T00:00:00</cs:createdDate>
            <cs:changeReason rdf:datatype="http://www.w3.org/2001/XMLSchema#string">new</cs:changeReason>
            </cs:ChangeSet>
        </skos:changeNote>
</rdf:Description>
</rdf:RDF>
```

LCSH "Climatic zones:" SKOS selections (1)

<rdf:Description rdf:about="http://id.loc.gov/authorities/subjects/sh85027043">

<rdf:type rdf:resource="http://www.w3.org/2004/02/skos/core#Concept"/>

<skos:prefLabel xml:lang="en"
xmlns:skos="http://www.w3.org/2004/02/skos/core#">Climatic zones</skos:prefLabel>

<skosxl:altLabel xmlns:skosxl="http://www.w3.org/2008/05/skos-xl#">
<rdf:Description>
<rdf:type rdf:resource="http://www.w3.org/2008/05/skos-xl#Label"/>
<skosxl:literalForm xml:lang="en">Zones, Climatic</skosxl:literalForm>
</rdf:Description>
</skosxl:altLabel>

<skos:related rdf:resource="http://id.loc.gov/authorities/subjects/sh85027038"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"/>

LCSH "Climatic zones:" SKOS selections (2)

<rdf:Description rdf:about="http://id.loc.gov/authorities/subjects/sh85027043">
<skos:prefLabel xml:lang="en"
xmlns:skos="http://www.w3.org/2004/02/skos/core#">Climatic zones</skos:prefLabel>

<skos:exactMatch
rdf:resource="http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb120105121"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"/>

<skos:exactMatch rdf:resource="http://aims.fao.org/aos/agrovoc/c_1669"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"/>

<skos:closeMatch rdf:resource="http://d-nb.info/gnd/4128757-5"
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<skos:closeMatch rdf:resource="http://d-nb.info/gnd/4164202-8"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"/>

LCSH "Climatic zones:" SKOS selections (3)

<rdf:Description rdf:about="http://id.loc.gov/authorities/subjects/sh85027043">
<skos:prefLabel xml:lang="en" xmlns:skos="http://www.w3.org/2004/02/skos/core#">Climatic zones</skos:prefLabel>

<skos:changeNote xmlns:skos="http://www.w3.org/2004/02/skos/core#">
<cs:ChangeSet xmlns:cs="http://purl.org/vocab/changeset/schema#">
<cs:subjectOfChange rdf:resource="http://id.loc.gov/authorities/subjects/sh85027043"/>
<cs:creatorName>Library of Congress, Network Development and MARC Standards Office</cs:creatorName>
<cs:createdDate rdf:datatype="http://www.w3.org/2001/XMLSchema#dateTime">1986-02-11T00:00:00</cs:createdDate>
<cs:changeReason
rdf:datatype="http://www.w3.org/2001/XMLSchema#string">new</cs:changeReason>
</cs:ChangeSet>
</skos:changeNote>

Indira Gándhí examples

- See separate documents