

Publishing Vocabularies on the Web

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Acknowledgements

- Alistair Miles, Dan Brickley, Mark van Assem, Jan Wielemaker, Bob Wielinga
- Participants of the W3C Semantic Web Best Practices and the Semantic Web Deployment Working Groups

Overview

- Issues in conversion to RDF/OWL
 - Example: Union List of Artist Names (ULAN)
 - Example: WordNet 2.0
- Work within the W3C Semantic Web Deployment Working Group
 - SKOS model for thesauri
 - Recipes for Web access to published vocabularies
 - RDFa: embedding RDF metadata in HTML

Thesauri / vocabularies

- Controlled vocabularies

Thesauri, classification schemes, taxonomies, subject heading lists, authority lists...

- Large bodies of knowledge that represent consensus in particular domains
- Often lots of implicit semantics available
- Semantic Web Challenge showed that thesauri are important resources for SW applications
- Representation is typically relational database and/or XML

Example thesauri

- Domain-specific vocabularies
 - Medicine: UMLS, SNOMED, MESH, Galen
 - Art history: AAT, ULAN
 - Geography: TGN
 - Food: AgroVoc
 - Libraries: LCSH, DDC, UDC
- Generic vocabularies
 - Lexical vocabularies: WordNet, FrameNet
 - Currencies, country codes, ...

ISO standard for representing thesauri

- Term
 - Preferred term (USE)
 - Non-preferred term (USED FOR)
- Hierarchical relation between terms
 - Broader/narrower term (BT/NT)
 - Generic
 - Partitive
- Association between terms (RT)

Typical conversion process

- Two steps
- Step 1: “As is” conversion
 - Keep original names/constructs
 - Make implicit semantics explicit (not trivial!)
 - Decisions on whether to keep all information
- Step 2: adding semantics
 - Separate file(s)
 - Interpretation of thesauri features, e.g. hyponym relation as **rdfs:subClassOf**
 - May require (lots of) additional research

Example thesaurus: ULAN

- 300,000 “Subject” records (artists and art institutions)
 - with biographical information (place/time birth/death)
 - and relations to other artists (student-of, ...)
- Large XML file with all data
- Basic representation:
 - association links between subjects
 - preferred/non-preferred terms relations between subjects and terms



Union List of Artist Names® Online

Full Record Display

[New Search](#)


[Previous Page](#)

[Help](#)

Click the  icon to view the hierarchy.

ID: 500000351

Record Type: [Person](#)

 **Koninck, Philips de** (Dutch painter and draftsman, 1619-1688)

Note: History and portrait painter who is today most well-known for his naturalistic panoramic bird's-eye view landscapes.

Birth and Death Places:

Born: [Amsterdam \(North Holland, Netherlands\) \(inhabited place\)](#)

Died: [Amsterdam \(North Holland, Netherlands\) \(inhabited place\)](#)

Related People or Corporate Bodies:

related to (familial) [Koninck, Salomon](#)

..... (Dutch painter, printmaker, and draftsman,
..... 1609-1656) [500027532]

sibling of [Koninck, Jacob, the elder](#)

..... (Dutch painter and engraver, ca. 1616-1708) [500024292]

student of [Rembrandt van Rijn](#)

..... (Dutch painter, draftsman, and printmaker, 1606-1669)
..... [500011051]

XML fragment of ULAN: links

```
<Associative_Relationships>
  <Associative_Relationship>
    <Historic_Flag>NA</Historic_Flag>
    <Relationship_Type>
      1102/student of
    </Relationship_Type>
    <Related_Subject_ID>
      <VP_Subject_ID>500011051</VP_Subject_ID>
    </Related_Subject_ID>
  </Associative_Relationship>
</Associative_Relationships>
```

Conversion issues

- XML and RDF/OWL are inherently different
 - XML = thesaurus document structure
 - RDF = thesaurus document content
- Redundant/meaningless information in XML file
 - <Associative_Relationships>**
 - <Historic_Flag>NA</Historic_Flag>**
- How to represent “student of”?
 - Subproperty of **Associative_Relationship** is probably preferred
 - Needs to be derived from the data; not part of schema

XML fragment of ULAN: terms

```
<Non-Preferred_Term>  
  <Term_Text>Koning, Philips Aertsz. de</Term_Text>  
  <Term_ID>1500207734</Term_ID>  
  <Display_Order>34</Display_Order>  
  <Vernacular>Vernacular</Vernacular>  
</Non-Preferred_Term>
```

Conversion issues

- Do we include all information in the conversion?
 - Display order
- Should each term have a URI?
- Making language explicit
 - “vernacular” means the string is written in the original language
 - Multi-linguality is an important issue for thesauri



RDF/OWL Representation of WordNet

W3C Working Draft 19 June 2006

This version:

<http://www.w3.org/TR/2006/WD-wordnet-rdf-20060619/>

Latest version:

<http://www.w3.org/TR/wordnet-rdf/>

Previous version:

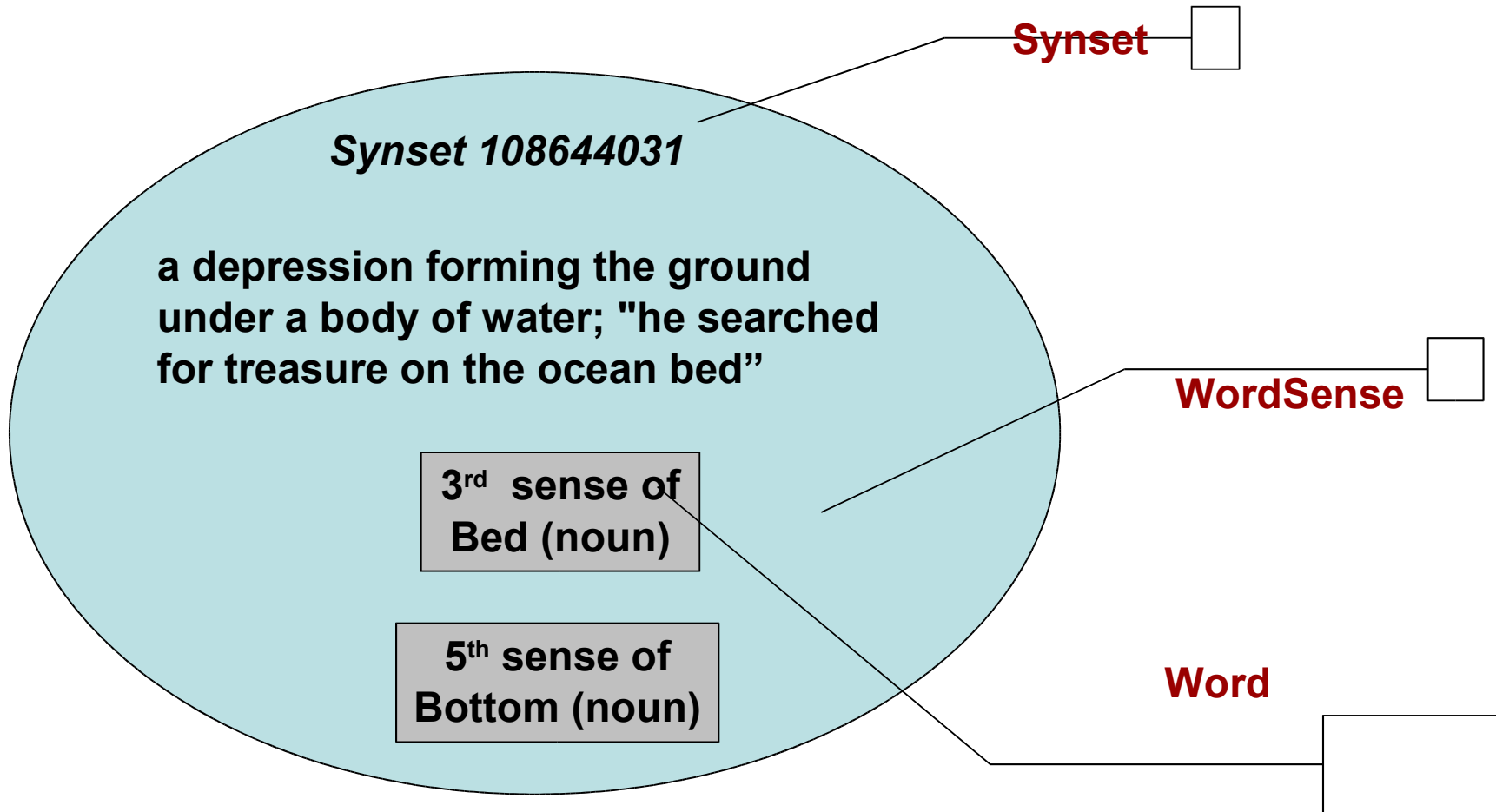
This is the first published version

Editors:

[Mark van Assem](#), Vrije Universiteit Amsterdam

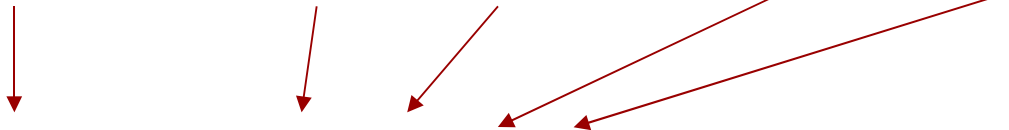
[Aldo Gangemi](#), ISTC-CNR, Rome

WordNet model



WordNet: internal representation

| SynsetID | Order | LexForm | Type | SenseNum |
|----------|-------|---------|------|----------|
|----------|-------|---------|------|----------|



s(108644031,1,'bed',n,3,2).
s(108644031,2,'bottom',n,5,1).

s(102719813,1,'bed',n,1,51).

g(108644031,'(a depression forming the ground under a body of water; "he searched for treasure on the ocean bed"))).

g(102719813,'(a piece of furniture that provides a place to sleep; "he sat on the edge of the bed"; "the room had only a bed and chair"))).

WordNet URIs

- What URIs should be chosen?
 - SynSet, WordSense, Word
- URI name:
 - ID? => difficult for human interpretation
 - Human-readable concatenation

wn:synset-bank-noun-2

synset denoted by second sense of “bank”

wn:wordsense-bank-noun-1

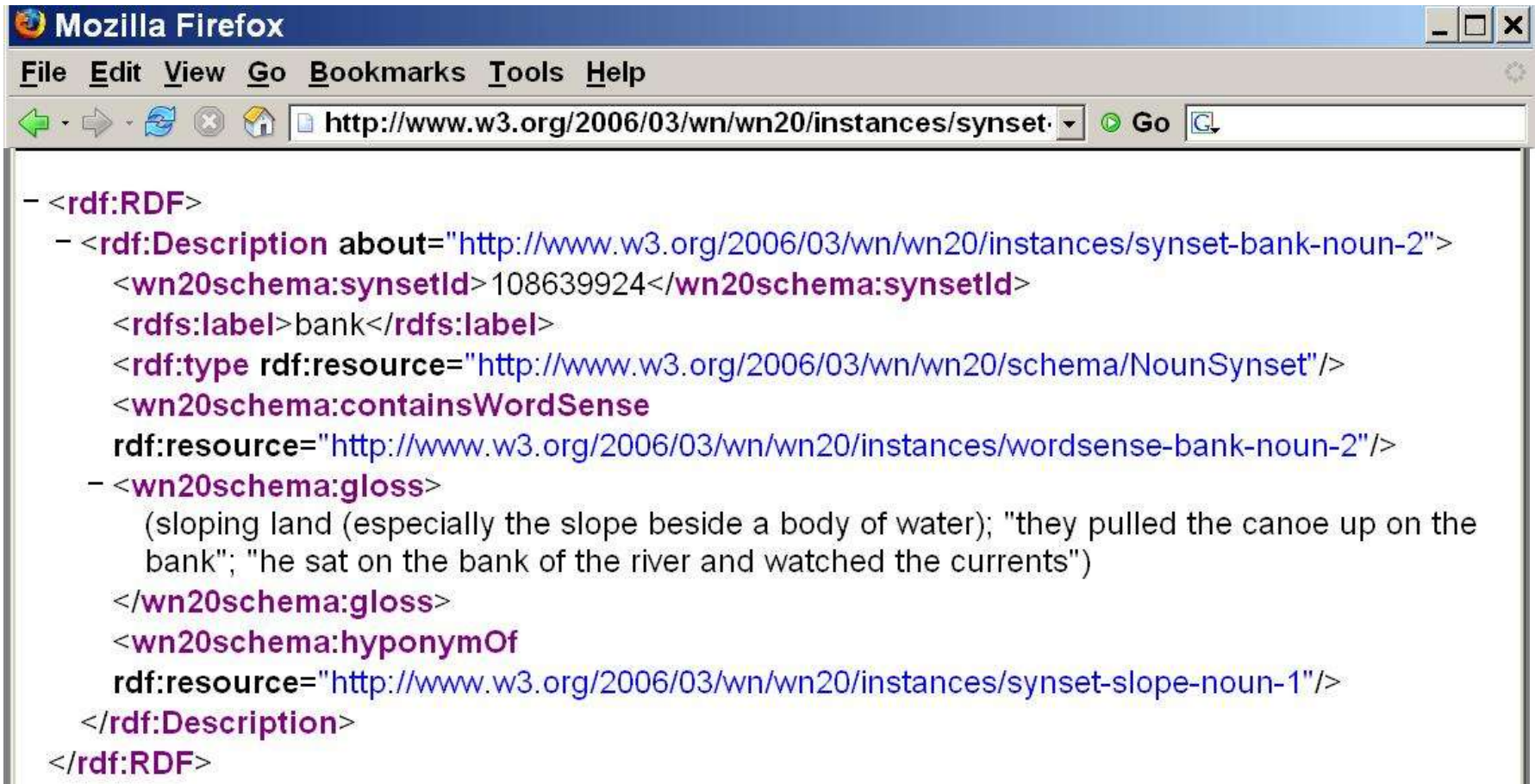
wn:word-bank

Implicit WordNet semantics

*“The **ent** operator specifies that the second synset is an entailment of first synset. This relation only holds for verbs.”*

- Example: [breathe, inhale] entails [sneeze, exhale]
- Semantics (OWL statements):
 - Transitive property
 - Inverse property: entailedBy
 - Value restrictions for VerbSynset (subclass of Synset)

Data access



The screenshot shows a Mozilla Firefox browser window with the address bar displaying the URL `http://www.w3.org/2006/03/wn/wn20/instances/synset-`. The main content area displays an RDF query result for the URI `http://www.w3.org/2006/03/wn/wn20/instances/synset-bank-noun-2`. The result is an XML-like structure with the following elements:

```
- <rdf:RDF>
  - <rdf:Description about="http://www.w3.org/2006/03/wn/wn20/instances/synset-bank-noun-2">
    <wn20schema:synsetId>108639924</wn20schema:synsetId>
    <rdfs:label>bank</rdfs:label>
    <rdf:type rdf:resource="http://www.w3.org/2006/03/wn/wn20/schema/NounSynset"/>
    <wn20schema:containsWordSense
      rdf:resource="http://www.w3.org/2006/03/wn/wn20/instances/wordsense-bank-noun-2"/>
  - <wn20schema:gloss>
    (sloping land (especially the slope beside a body of water); "they pulled the canoe up on the
    bank"; "he sat on the bank of the river and watched the currents")
  </wn20schema:gloss>
  <wn20schema:hyponymOf
    rdf:resource="http://www.w3.org/2006/03/wn/wn20/instances/synset-slope-noun-1"/>
  </rdf:Description>
</rdf:RDF>
```

- Query for WordNet URI returns “concept-bounded description”

Overview

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 - Example: Union List of Artist Names (ULAN)
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- Work within the W3C Semantic Web Deployment Working Group
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W3C Semantic Web Deployment Working Group

**Making vocabularies/thesauri/ontologies
available on the Web**

[**http://www.w3.org/2006/07/SWD/**](http://www.w3.org/2006/07/SWD/)

SWD goals

- Schema for interoperable RDF/OWL representation of vocabularies
 - SKOS
- Publication guidelines
 - URI management, representation of versions
- Embedding RDF in (X)HTML pages
 - RDFa



NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION

+ Visit
NASA.gov
+ Contact the
NASA Curator

+ TAXONOMY TOP LEVEL FACETS

+ FAQs

+ NASA METADATA

– NASA TAXONOMY XML

+ NASA XML PROJECT

NASA Taxonomy - XML DTDs for Use with the NASA Taxonomy

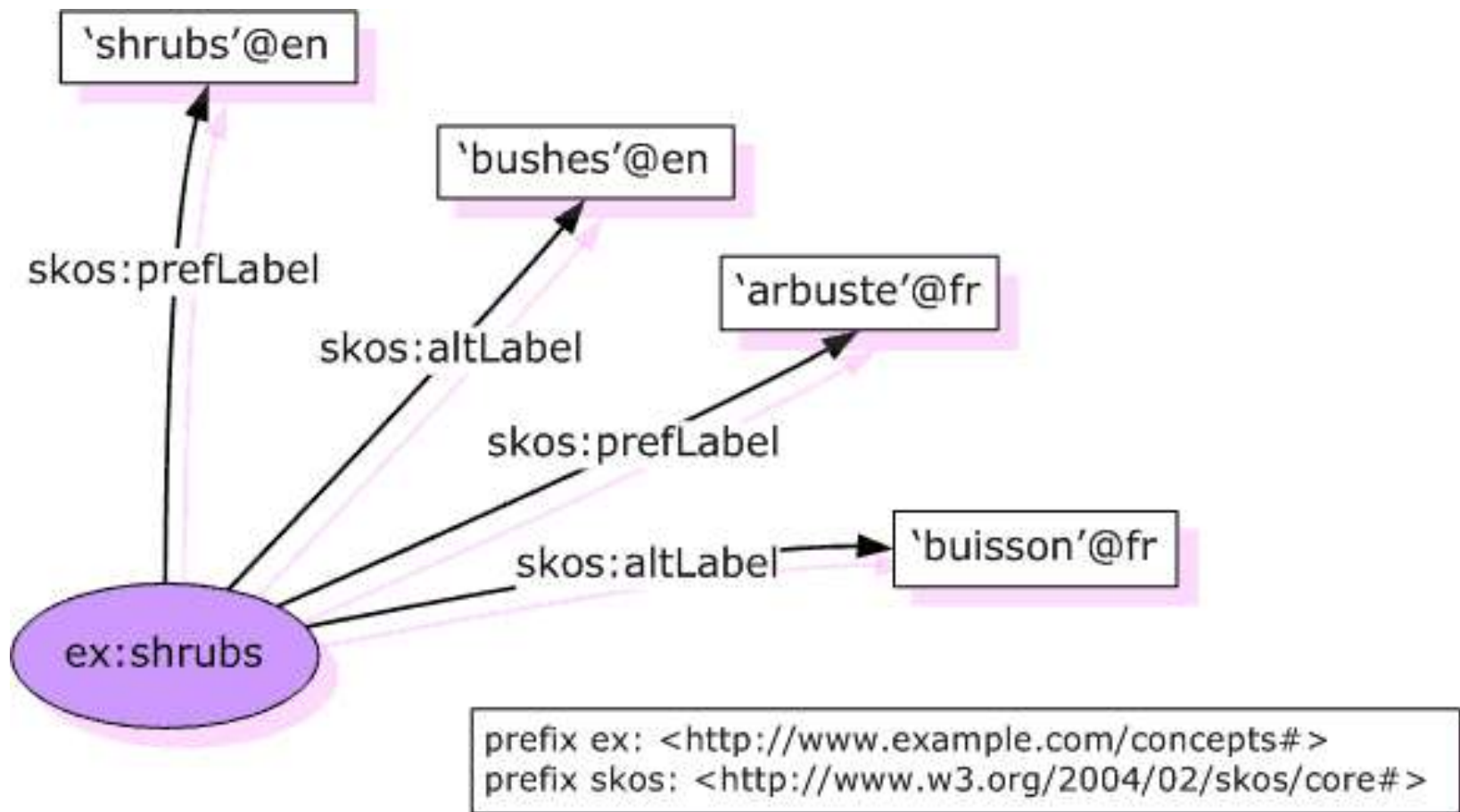
Important Update Regarding the XML format of the NASA Taxonomy - Jan 9, 2007

The next version of the NASA taxonomy will be in the [SKOS format](#).

The SKOS Core is a model and an RDF vocabulary proposed by the W3C for expressing the basic structure and content of concept schemes such as thesauri, classification schemes, subject heading lists, taxonomies, other types of controlled vocabulary.

The SKOS Core Vocabulary is an application of the [Resource Description Framework \(RDF\)](#), that can be used to express a

Multi-lingual labels for concepts



Documenting concepts

skos:note

|

+-- skos:definition

|

+-- skos:scopeNote

|

+-- skos:example

|

+-- skos:historyNote

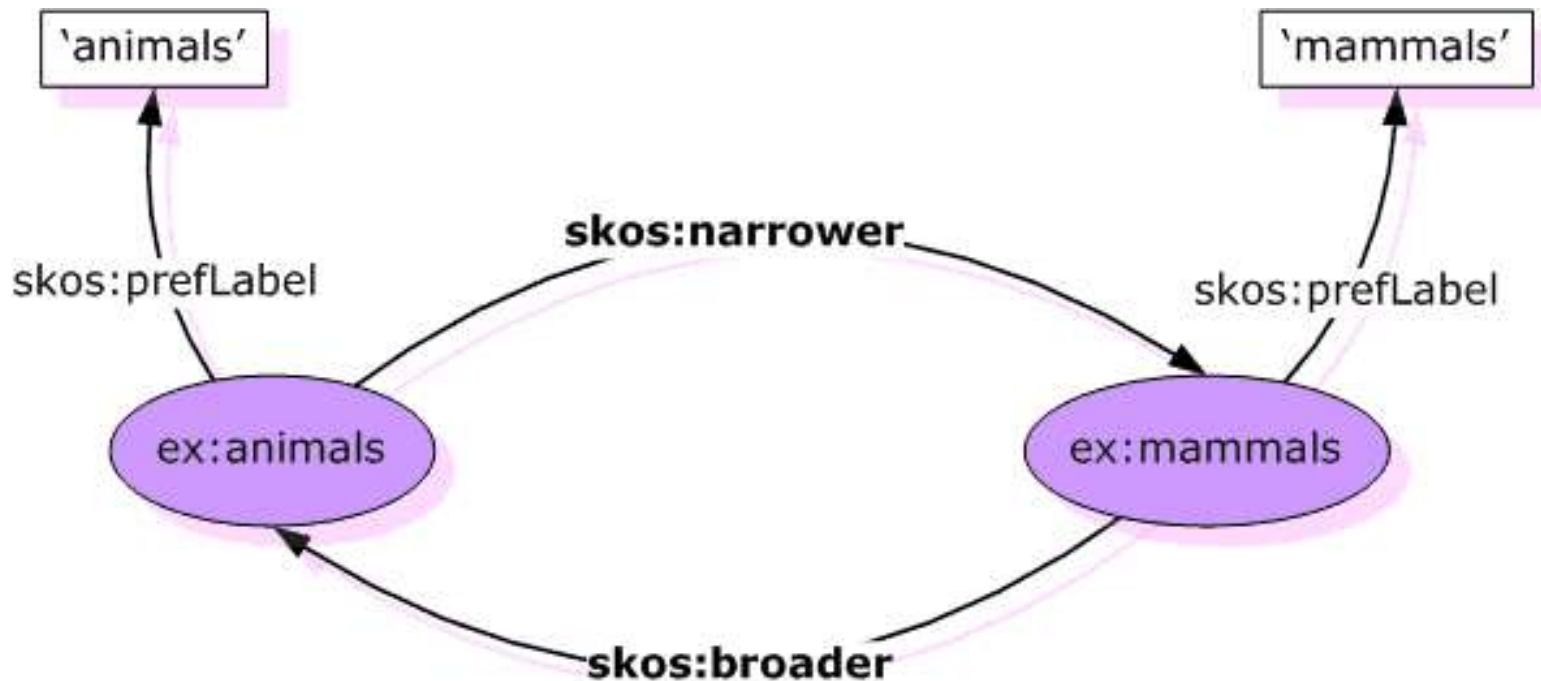
|

+-- skos:editorialNote

|

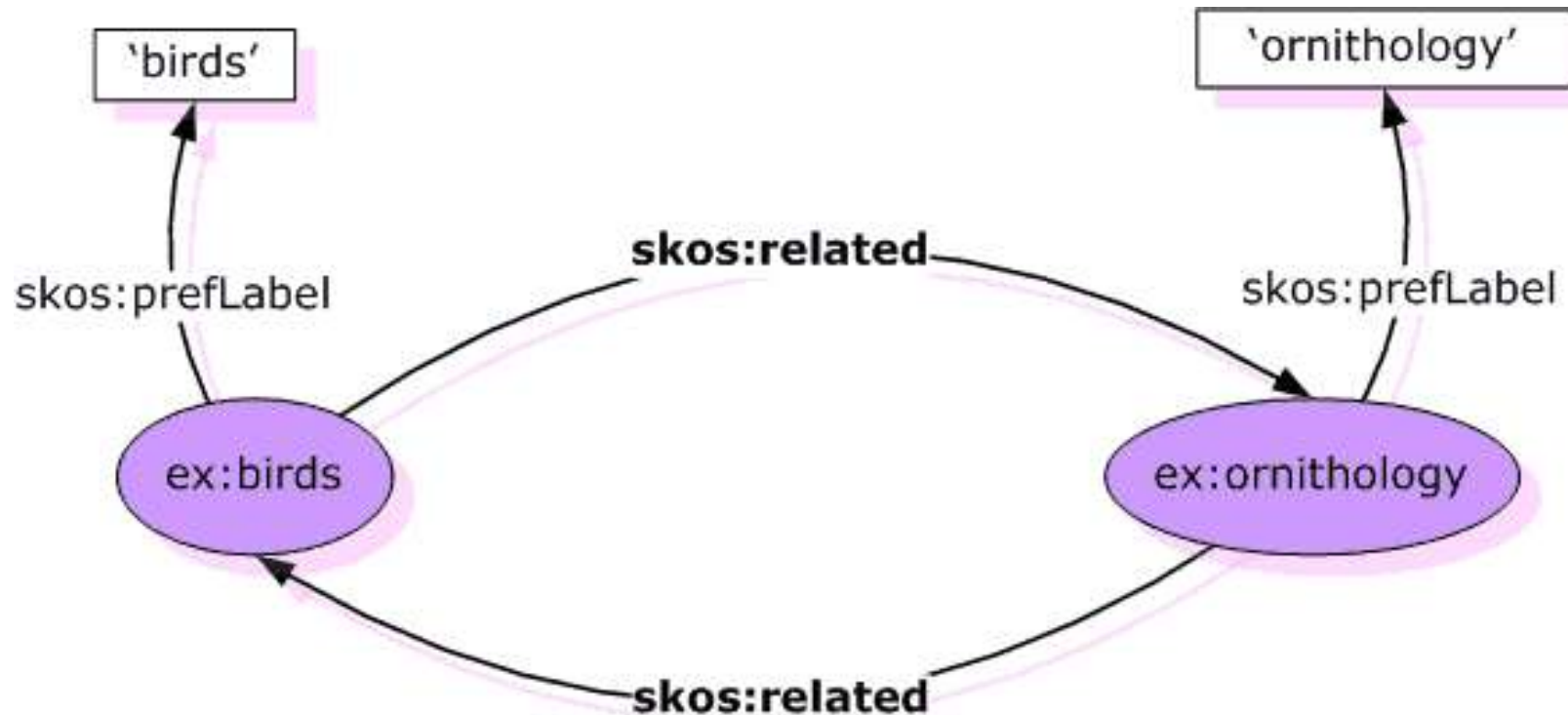
+-- skos:changeNote

Semantic relation: **broader** and **narrower**



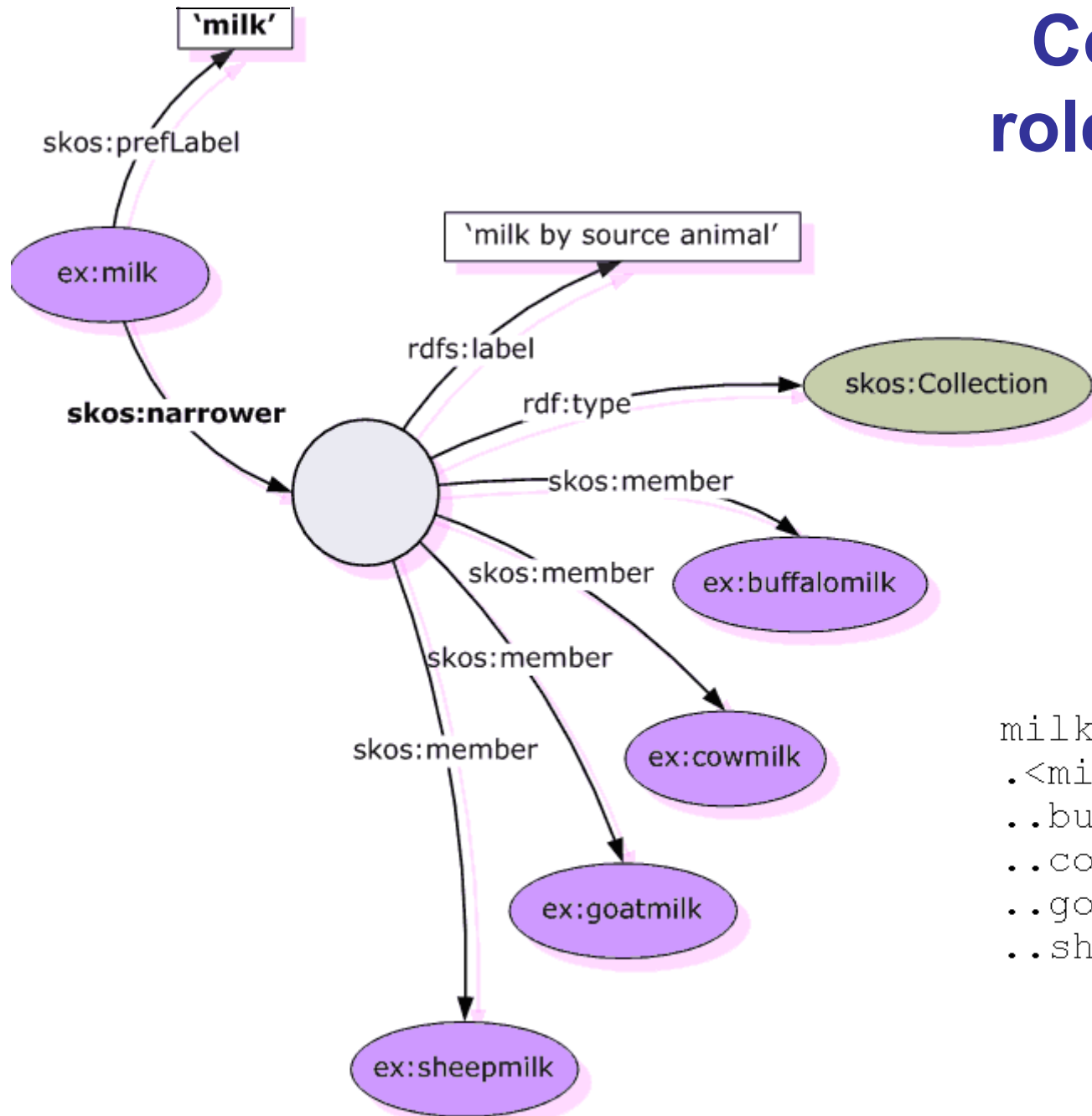
prefix ex: <<http://www.example.com/concepts#>>
prefix skos: <<http://www.w3.org/2004/02/skos/core#>>

Semantic relations: **related**



prefix ex: <<http://www.example.com/concepts#>>
prefix skos: <<http://www.w3.org/2004/02/skos/core#>>

Collections: role-type trees

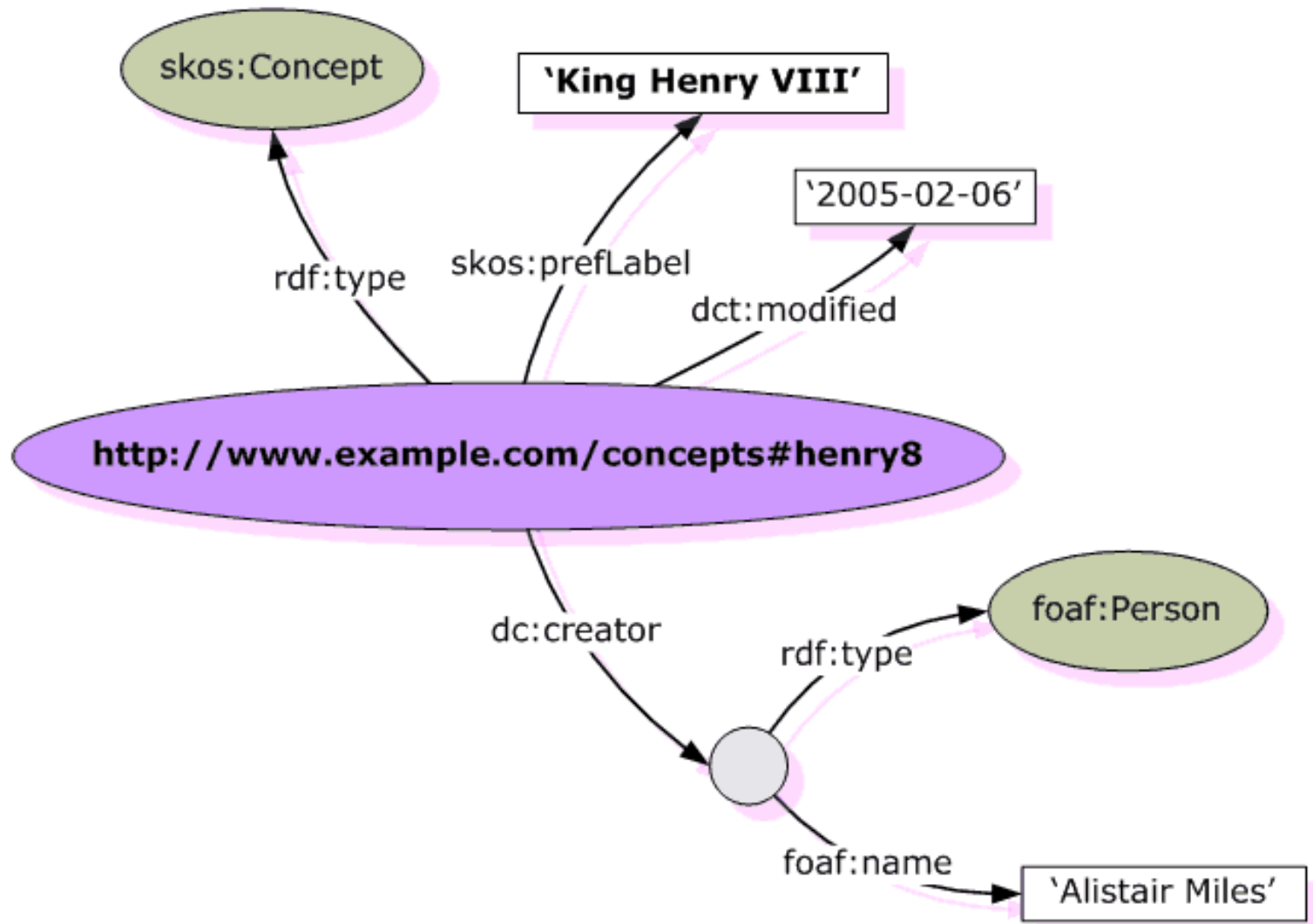


```
milk
.<milk by source animal>
..buffalo milk
..cow milk
..goat milk
..sheep milk
```

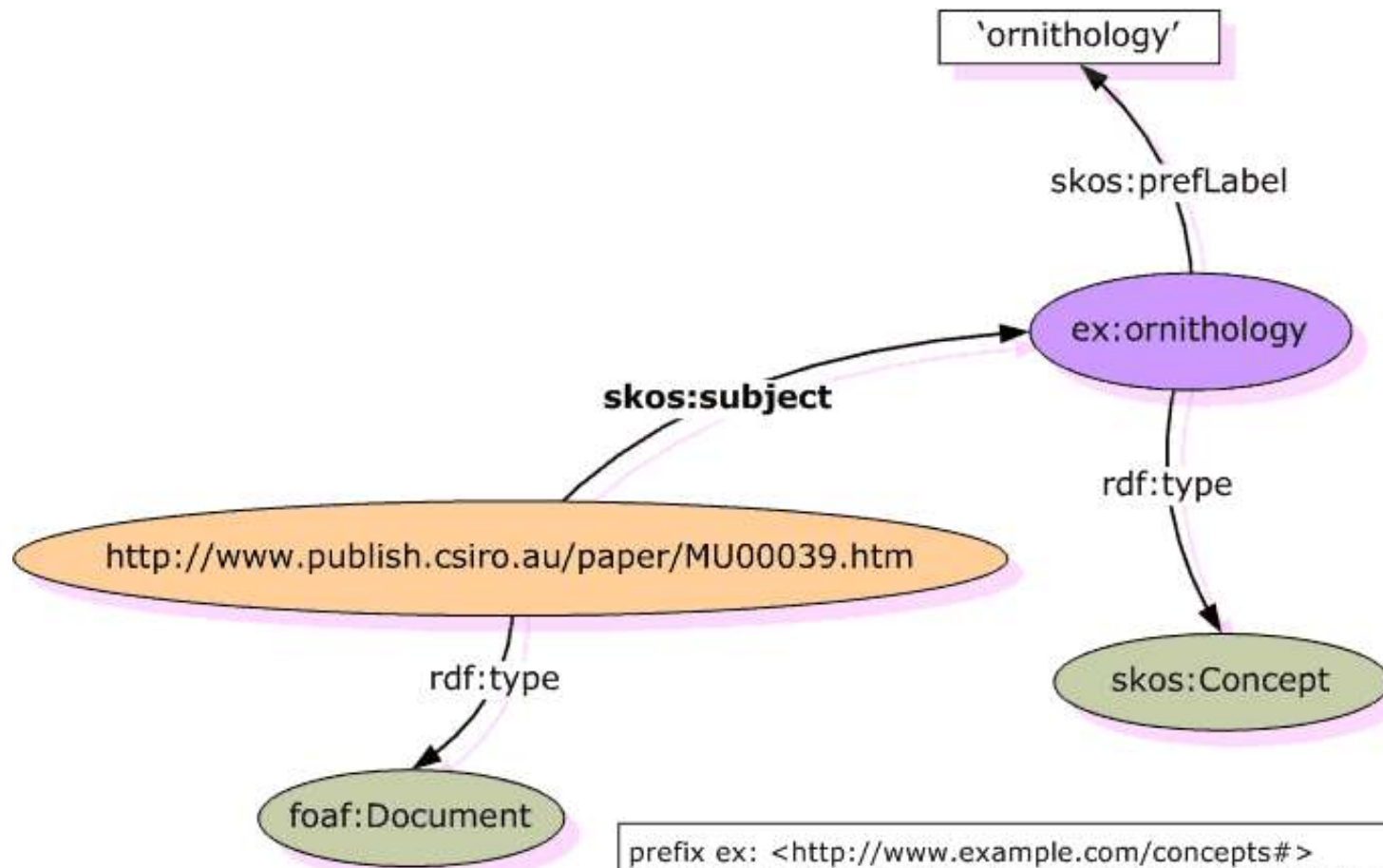
Adding semantics

- Adding OWL statements
 - **skos:related** **rdf:type** **owl:SymmetricProperty**
 - **skos:broader** **owl:inverseOf** **skos:narrower**
- Inference rules
 - Collection membership rule
(?s skos:narrower ?c) (?c skos:member ?t)
→ **(?s skos:narrower ?t)**
- Interpreting thesaurus relations such as **broader** as **subClassOf** can be useful but is often imprecise

SKOS semantics: concepts are not the real things



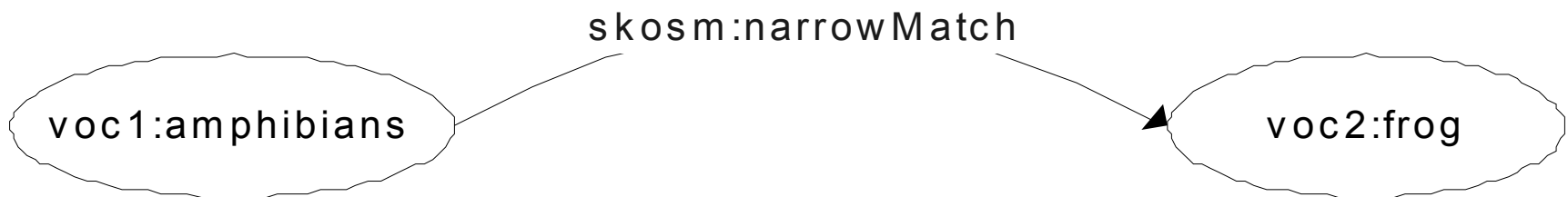
Indexing a resource with a SKOS concept



```
prefix ex: <http://www.example.com/concepts#>  
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>  
prefix skos: <http://www.w3.org/2004/02/skos/core#>  
prefix foaf: <http://xmlns.com/foaf/0.1/>
```

Semantic alignment links

- Learning relations between thesauri is important form of additional semantics
 - Example: AAT contains styles; ULAN contains artists, but there is no link
 - Availability of this kind of alignment knowledge is extremely useful
 - Cf. [demo](#)



Warning: unstable part of SKOS!

W3C standardization process

- Input: draft specification
- Collect use cases
- Derive requirements
- Create issues list: requirements that cannot be handled by the draft spec
- Propose resolutions for issues
- Get consensus on amended spec
- Find two independent implementations for each feature in the spec
- *Continuously*: ask for public feedback/comments

(YES, YOU!)



SKOS Use Cases and Requirements

W3C Working Draft 16 May 2007

This version:

<http://www.w3.org/TR/2007/WD-skos-ucr-20070516/>

Latest version:

<http://www.w3.org/TR/skos-ucr>

Previous version:

This is the first public Working Draft

Editors:

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Daniel Rubin, Stanford Medical Informatics, dlrubin@stanford.edu

Example use case and requirement

- **2.3 Use Case #3 — Semantic search service across mapped multilingual thesauri in the agriculture domain**

“This application coming from the AIMS project [...] includes some more specific links [...] String-to-String relationships ...”

| | | |
|------------------|-----------------------------------|--------------|
| acronym | Food and Agriculture Organization | FAO |
| spelling_variant | organisation | organization |
| translation | vache | cow |

“Requires: [...] **R-RelationshipsBetweenLabels**”

Example issue: relationships between lexical labels

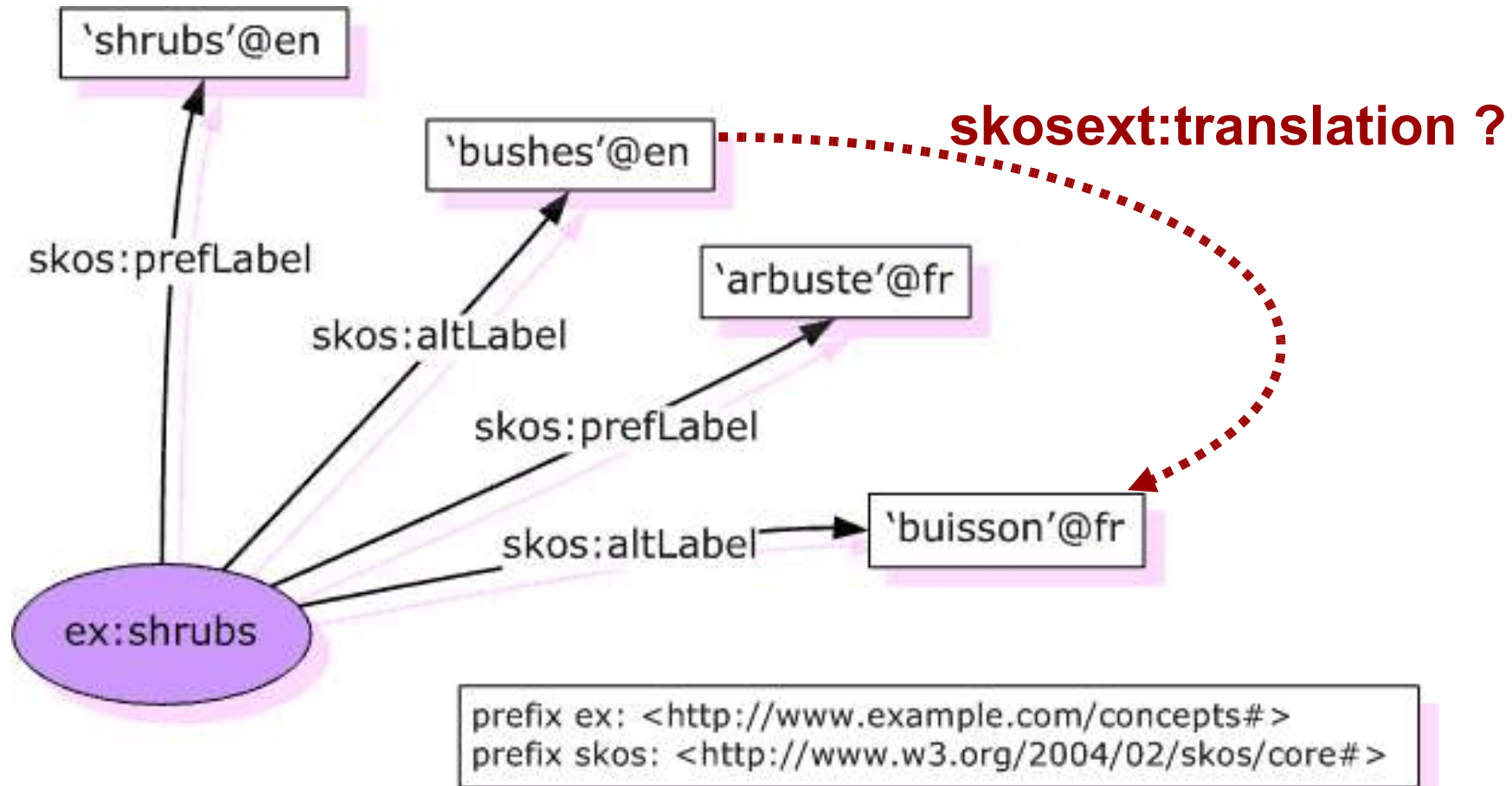
“R-RelationshipsBetweenLabels

Representation of links between labels associated to concepts

The SKOS model shall provide means to represent relationships between the terms associated with concepts. Typical examples are [...]”

- In current SKOS spec labels are represented as literals
- This is a problem because literals have no URI, so cannot be subject of an RDF property
- Possible resolutions:
 - Labels/terms as instances of a new class
 - Relaxing constraints on label property

Example issue: relationships between lexical labels



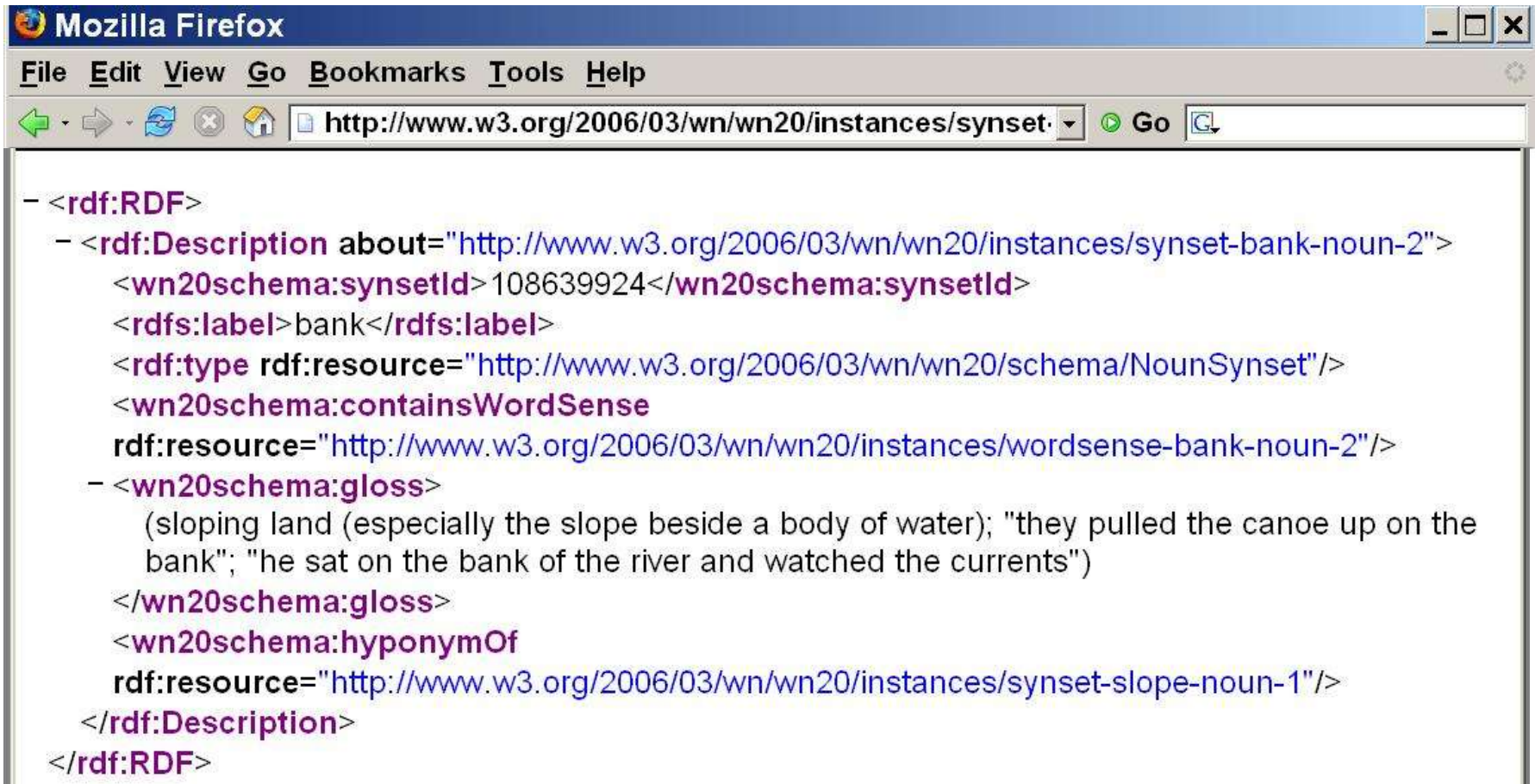
SWD goals

- Schema for interoperable RDF/OWL representation of vocabularies
 - SKOS
- **Publication guidelines**
 - URI management, representation of versions
- Embedding RDF in (X)HTML pages
 - RDFa

Recipes for vocabulary URIs

- Simplified rule:
 - Use “hash” variant” for vocabularies that are relatively small and require frequent access
<http://www.w3.org/2004/02/skos/core#Concept>
 - Use “slash” variant for large vocabularies, where you do not want always the whole vocabulary to be retrieved
[http://www.w3.org/\[...\]/instances/synset-bank-noun2](http://www.w3.org/[...]/instances/synset-bank-noun2)

Data access



The screenshot shows a Mozilla Firefox browser window with the address bar displaying the URL `http://www.w3.org/2006/03/wn/wn20/instances/synset-`. The main content area displays an RDF query result for the URI `http://www.w3.org/2006/03/wn/wn20/instances/synset-bank-noun-2`. The result is an XML snippet showing the `<rdftype>` and `<wn20schema:containsWordSense>` elements, along with the `<wn20schema:gloss>` and `<wn20schema:hyponymOf>` elements.

```
- <rdf:RDF>
  - <rdf:Description about="http://www.w3.org/2006/03/wn/wn20/instances/synset-bank-noun-2">
    <wn20schema:synsetId>108639924</wn20schema:synsetId>
    <rdfs:label>bank</rdfs:label>
    <rdf:type rdf:resource="http://www.w3.org/2006/03/wn/wn20/schema/NounSynset"/>
    <wn20schema:containsWordSense
      rdf:resource="http://www.w3.org/2006/03/wn/wn20/instances/wordsense-bank-noun-2"/>
  - <wn20schema:gloss>
    (sloping land (especially the slope beside a body of water); "they pulled the canoe up on the
    bank"; "he sat on the bank of the river and watched the currents")
    </wn20schema:gloss>
    <wn20schema:hyponymOf
      rdf:resource="http://www.w3.org/2006/03/wn/wn20/instances/synset-slope-noun-1"/>
    </rdf:Description>
  </rdf:RDF>
```

- Query for WordNet URI returns “concept-bounded description”

Recipes for serving RDF

- Persistent URIs and version-specific content
HTTP 303 redirection
 - Client asking `http://example.org/voc#myClass`
 - Client redirected to
`http://example.org/voc-files/voc-version3.rdf#myClass`
- For more information and other recipes, see:
<http://www.w3.org/TR/swbp-vocab-pub/>

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A RDFa sample

Regular HTML

```
<h1>Photo Album #12345: Vacation in the South of France</h1>  
<h2>created by Mark Birbeck</h2>
```

HTML with RDFa

```
<h1 property="dc:title">Vacation in the South of France</h1>  
<h2>created by <span property="dc:creator">Mark Birbeck</span></h2>
```

Resulting RDF statements

```
<> dc:title "Vacation in the South of France"^^XMLLiteral .  
<> dc:creator "Mark Birbeck"^^XMLLiteral .
```

Linking to other resources

Regular HTML

```
This document is licensed under a  
<a href="http://creativecommons.org/licenses/by-nc/2.5/">  
    Creative Commons Non-Commercial License  
</a>.
```

HTML with embedded RDF

```
This document is licensed under a  
<a rel="cc:license"  
    href="http://creativecommons.org/licenses/by-nc/2.5/">  
    Creative Commons Non-Commercial License  
</a>.
```

Statements about other resources: photo example

```
<li> ,  
  <span about="/user/markb/photo/23456" property="dc:title">  
    Sunset in Nice  
  </span>  
</li>  
  
<li> ,  
  <span about="/user/markb/photo/34567" property="dc:title">  
    W3C Meeting in Mandelieu  
  </span>  
</li>
```

RDFa demo

- *Having time, feeling lucky and online?*
- *Slides*

More information

 **W3C Semantic Web Deployment Working Group - Mozilla Firefox**

[File](#) [Edit](#) [View](#) [History](#) [Bookmarks](#) [Tools](#) [Help](#)

 <http://www.w3.org/2006/07/SWD/> 

 [Semantic Web](#) →

Semantic Web Deployment Working Group

The mission of this Working Group is to provide guidance in the form of W3C Technical Reports on issues of practical RDF development and deployment practices in the areas of publishing vocabularies, OWL usage, and integrating RDF with HTML documents.

Also On This Page → [Charter and History](#) • [Working Group Resources](#)

Mailing list and wiki

- ♦ Mailing list archives: [public-swd-wg](#)
- ♦ [Wiki](#)

Related Working Drafts:

- ♦ [Best Practice Recipes for Publishing RDF Vocabularies](#)
W3C Working Draft 14 March 2006, Miles, Baker, Swick (eds.)
- ♦ [RDF/A Primer 1.0; Embedding RDF in XHTML](#)
W3C Working Draft 10 March 2006, Adida, Birbeck (eds.)
- ♦ [SKOS Core Vocabulary Specification](#)
W3C Working Draft 2 November 2005, Miles, Brickley (eds.)
- ♦ [SKOS Core Guide](#)
W3C Working Draft 2 November 2005, Miles, Brickley (eds.)
- ♦ [Metainformation Module](#) and [Metainformation Attributes Module](#) of [XHTML 2.0](#)
W3C Working Draft 26 July 2006

Current and Upcoming Events

- WG teleconferences on Tuesdays at [1500 UTC](#)
- **22-26 January 2007**: W3C Multi-Group Meeting MIT, Cambridge MA. See [announcement](#).
- **4-10 November 2007**: Advisory Committee and Technical Plenary combined, Cambridge, MA (USA). See [announcement](#).

[...more W3C Events](#)

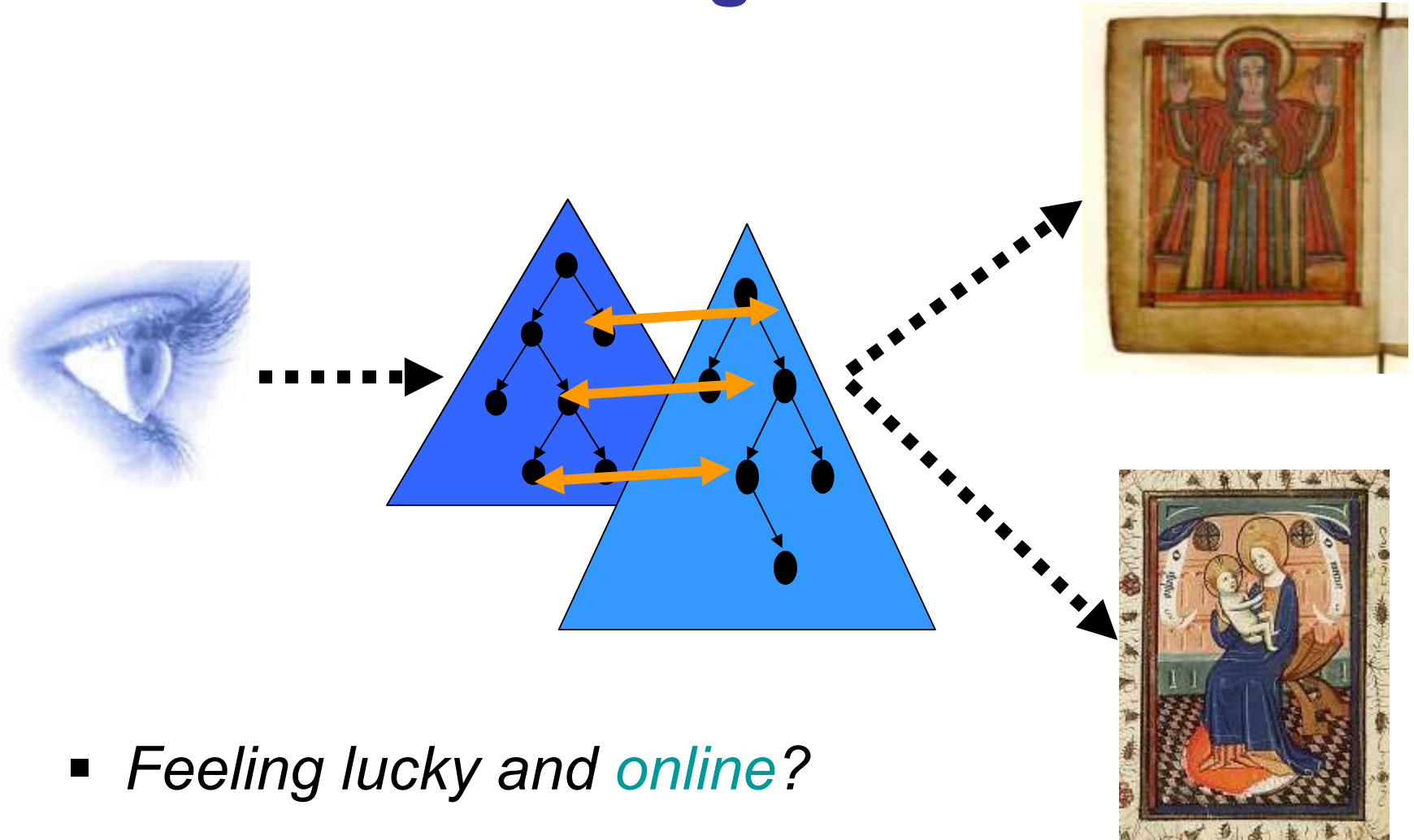
Nearby

- [Deliverables and Schedule](#)
- Mailing list archives: [public-swd-wg](#)
- [Wiki](#)
- [issues tracker](#)
- Notes on [scribing](#)

Thanks

- Reminder: we ask for feedback!
 - Questions and comments highly welcome
- aisaac at [few.vu.nl](mailto:aisaac@few.vu.nl)
- schreiber at [cs.vu.nl](mailto:schreiber@cs.vu.nl)
- Continue for demo?

SKOS Demo: browsing and alignment



- *Feeling lucky and **online**?*

[Back](#)

Demo: SKOS, browsing and alignment

Facetted Search - Mozilla Firefox

Eichier Edition Affichage Aller à Marque-pages Outils ?

http://stitch.cs.vu.nl/rp33333/MANDRA-SV-ICE-mandraNewNONE

Démarrage Laposte.net, adress... Clear

BNF KB Integrated Search (single view Iconclass,mandraNewNONE mapping)

NEW SEARCH

User Interface developed for the STITCH project based on "Flamenco Faceted Search"

Images from the Illuminated Manuscripts Collection of the National Library of the Netherlands combined with the Bibliothèque nationale de France Mandragore Collection

Questions or Comments? Email lourens@cs.vu.nl

version 0.20 (serql=sesame)

MAPPING: [mandraBASE](#) [mandraNewNONE](#)

VIEWS: [COMBINED VIEW](#) [SINGLE VIEW IC](#) [SINGLE VIEW IC\(Eng\)](#) [SINGLE VIEW IC\(Ger\)](#) [SINGLE VIEW](#) [MANDRA](#)

| Collection | IconClass(Eng) |
|---|---|
| Bibliothèque nationale de France Mandragore Collection (2170) | LOCAL (2310) |
| Illuminated Manuscripts Collection of the National Library of the Netherlands | Abstract Ideas and Concepts (85) |
| | Bible (1819) |
| | Classical Mythology and Ancient History (393) |
| | History (200) |
| | Human Being, Man in General (894) |
| | Literature (58) |
| | Nature (954) |
| | Religion and Magic (1679) |
| | Society, Civilization, Culture (1952) |

Subject vocabulary, collection 1

Subjects

Demo: SKOS, browsing and alignment

Hierarchical path
from root to selected
subject

version 0.20 (serql=sesame)

MAPPING: [mandraBASE](#) [mandraNewNONE](#)

Refine your search further within these categories:

Collection

- [Illuminated Manuscripts](#)
- [Collection of the National Library of the Netherlands](#) (3)


IconClass(Eng): [all](#) > [Nature](#) > [earth, world as celestial body](#) > [animals](#) > [amphibians](#)

[tailless amphibians](#) (3)

These terms define your current search. Click the ☐ to remove a term.

IconClass(Eng): [Nature](#) > [earth, world as celestial body](#) > [animals](#) > [amphibians](#)

Found 3 objects



Possible
specialization for
selected subject

Demo: SKOS, browsing and alignment

Semantic alignment
of subjects activated

version 0.20 (serql=sesame)

MAPPING: [mandraBASE](#) [mandraNewNONE](#)

Refine your search further within these categories:

Collection

[Bibliothèque nationale de France Mandragore Collection](#) (6) [Illuminated Manuscripts Collection of the National Library of the Netherlands](#) (5)

IconClass(Eng): [all](#) > [Nature](#) > [earth, world as celestial body](#) > [animals](#) > [amphibians](#)

LOCAL (8) [tailless amphibians](#) (3)

These terms define your current search. Click the ☐ to remove a term.

IconClass(Eng): [Nature](#) > [earth, world as celestial body](#) > [animals](#) > [amphibians](#)

Found 11 objects



Document from
Collection 2

Demo: SKOS, browsing and alignment

version 0.20 (serql=sesame)

Title: Fable : le cobra et les grenouilles

Picture:



Image taille réelle: <http://visualiseur.bnf.fr/Visualiseur?Destination=Mandragore>

MANDRAGORE: plante

MANDRAGORE: naja

MANDRAGORE: grenouille

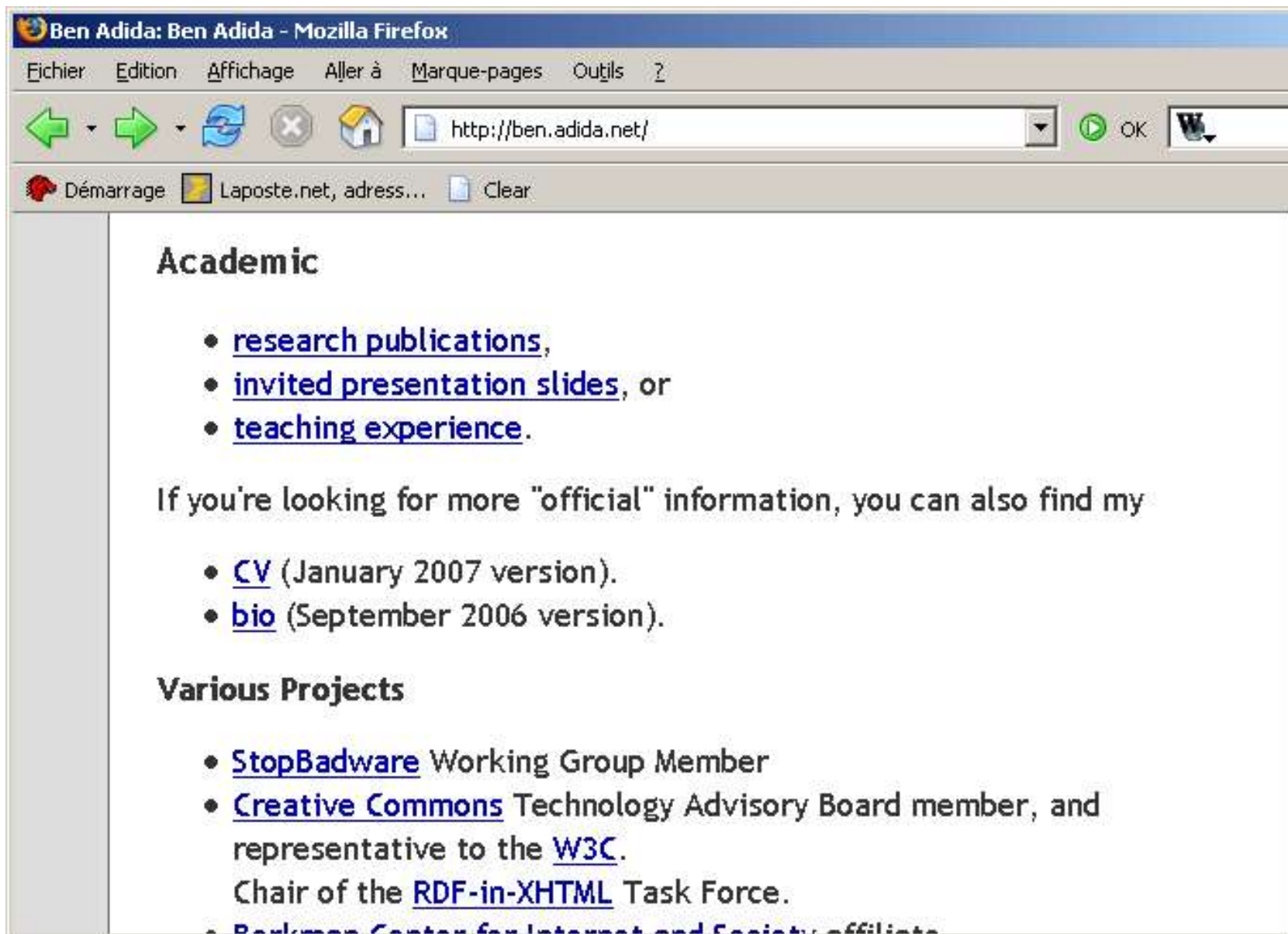
MANDRAGORE: fable

MANDRAGORE: arbre

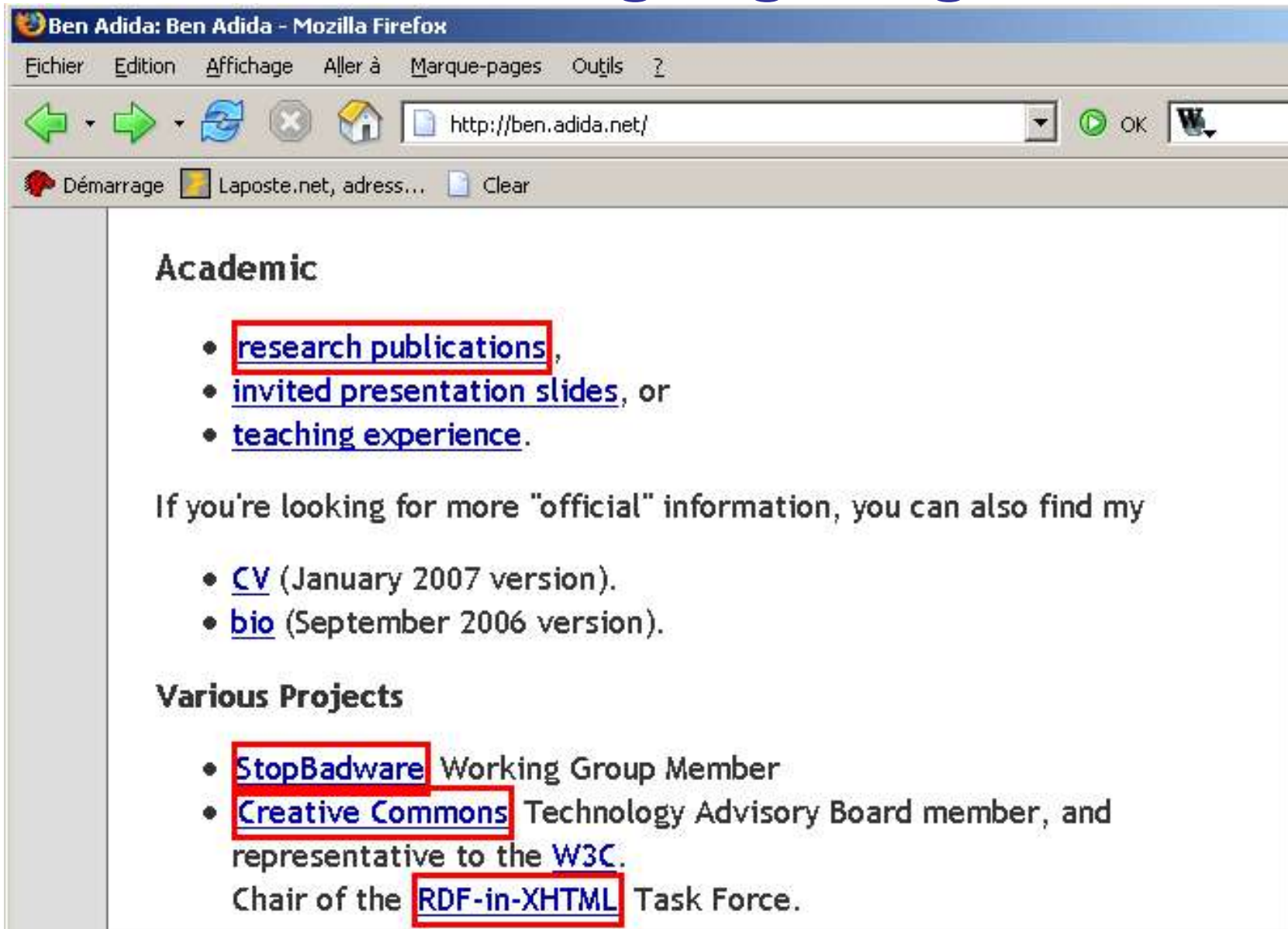
DATE: 13e siècle

Subject from voc2 aligned to
voc1:amphibians”

RDFa demo: a page with RDFa



RDFa demo: highlighting RDFa



The screenshot shows a Mozilla Firefox browser window with the title "Ben Adida: Ben Adida - Mozilla Firefox". The address bar displays "http://ben.adida.net/". The page content includes a section titled "Academic" with a bulleted list of links: "research publications", "invited presentation slides", and "teaching experience". Below this is a paragraph: "If you're looking for more 'official' information, you can also find my" followed by a bulleted list of links: "CV (January 2007 version)" and "bio (September 2006 version)". Another section titled "Various Projects" follows, with a bulleted list of links: "StopBadware Working Group Member", "Creative Commons Technology Advisory Board member, and representative to the W3C", and "Chair of the RDF-in-XHTML Task Force". The links "research publications", "invited presentation slides", "teaching experience", "CV", "bio", "StopBadware", "Creative Commons", and "RDF-in-XHTML" are highlighted with red rectangular boxes.

Ben Adida: Ben Adida - Mozilla Firefox

Eichier Edition Affichage Aller à Marque-pages Outils ?

http://ben.adida.net/ OK

Démarrage Laposte.net, adress... Clear

Academic

- [research publications](#),
- [invited presentation slides](#), or
- [teaching experience](#).

If you're looking for more "official" information, you can also find my

- [CV](#) (January 2007 version).
- [bio](#) (September 2006 version).

Various Projects

- [StopBadware](#) Working Group Member
- [Creative Commons](#) Technology Advisory Board member, and representative to the [W3C](#).
- Chair of the [RDF-in-XHTML](#) Task Force.

RDFa demo: displaying triples

Ben Adida: Ben Adida - Mozilla Firefox

Eichier Edition Affichage Aller à Marque-pages Outils ?

http://ben.adida.net/ OK

Démarrage Laposte.net, adress... Clear

Academic

- [research publications](#),
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If you're looking for more "official" information, you can also find my

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RDFa Triples Close

<> [foaf:currentProject](#) <<http://creativecommons.org>>

- [StopBadware](#) working group member
- [Creative Commons](#) Technology Advisory Board member, and representative to the [W3C](#).

Chair of the [RDF-in-XHTML](#) Task Force.

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