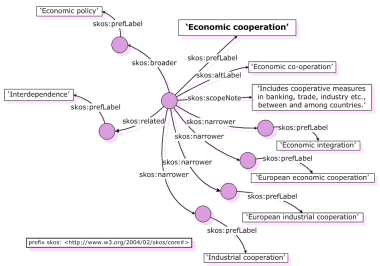
SKOS

COMP62342
Sean Bechhofer
sean.bechhofer@manchester.ac.uk



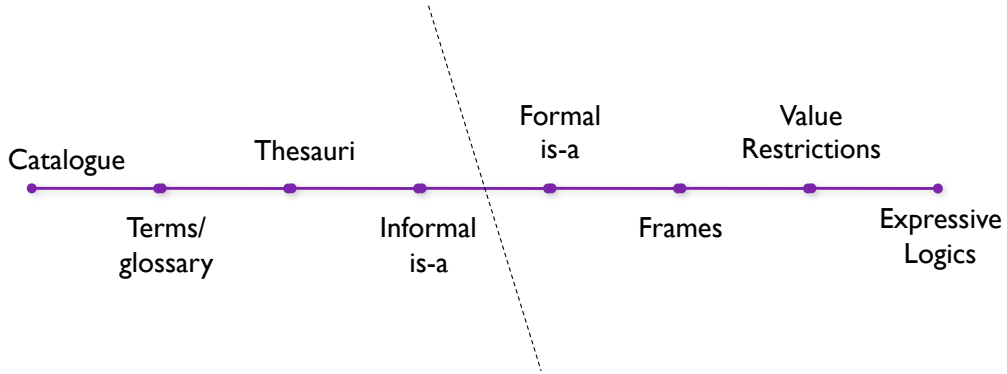
Ontologies

- **Metadata**
  - Resources marked-up with descriptions of their content. No good unless everyone **speaks the same language**;
- **Terminologies**
  - Provide shared and common vocabularies of a domain, so search engines, agents, authors and users can communicate. No good unless everyone **means the same thing**;
- **Ontologies**
  - Provide a **shared and common understanding** of a domain that can be communicated across people and applications, and will play a major role in supporting information exchange and discovery.

Ontology

- A representation of the **shared** background **knowledge** for a **community**
- Providing the **intended meaning** of a formal vocabulary used to describe a certain conceptualisation of objects in a domain of interest
- A **vocabulary** of terms plus explicit characterisations of the **assumptions** made in interpreting those terms
- Nearly always includes some notion of hierarchical **classification** (is-a)
- Richer languages allow the **definition** of classes through description of their characteristics

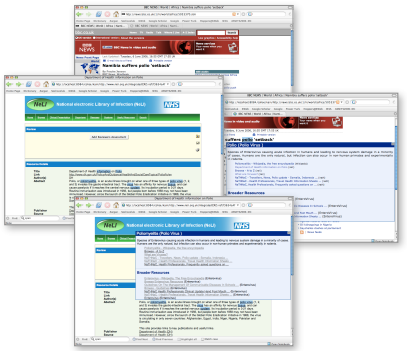
A Spectrum of Representation



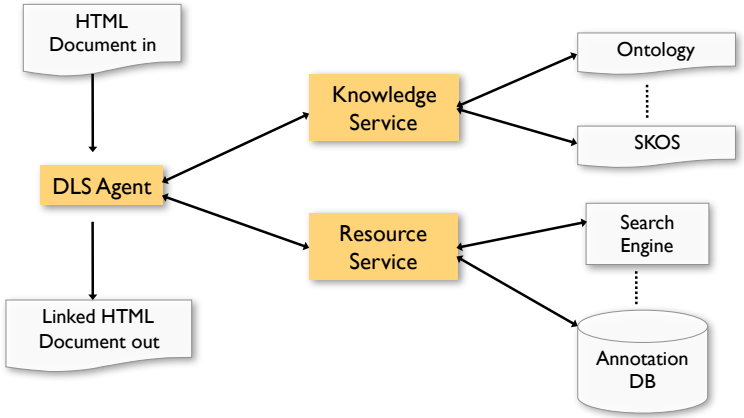
- Formal representations are not always the most appropriate for applications

COHSE

- Conceptual driven navigation around documents
- Simple text processing + vocabulary + open hypermedia architecture
  - Separating link and document
  - Explicit navigation around a domain vocabulary
- DLS agent adds links to documents based on the occurrence of concepts in those documents.



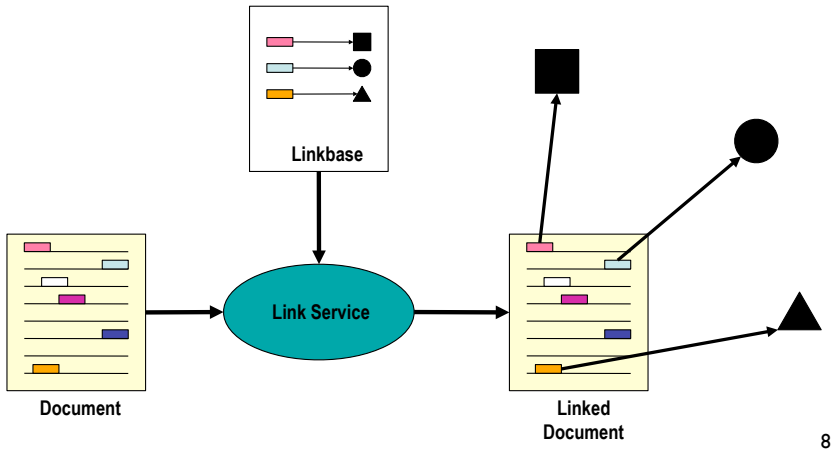
COHSE's Architecture



Demo

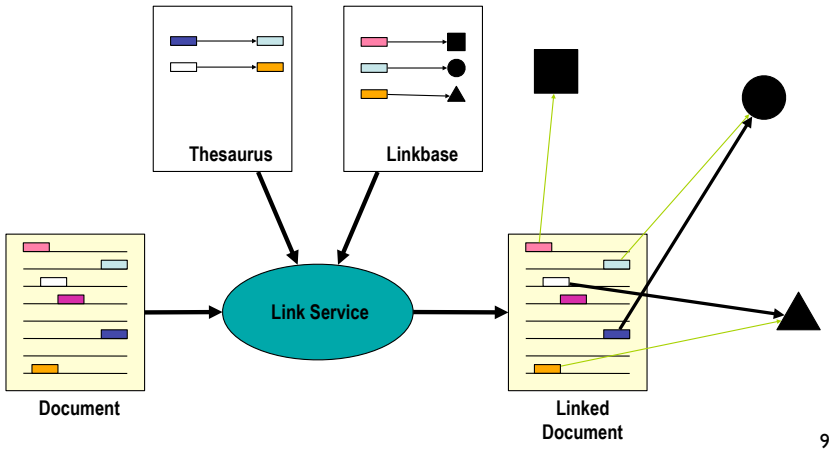
Generic Links

- Generic Links in Open Hypermedia are based on words.



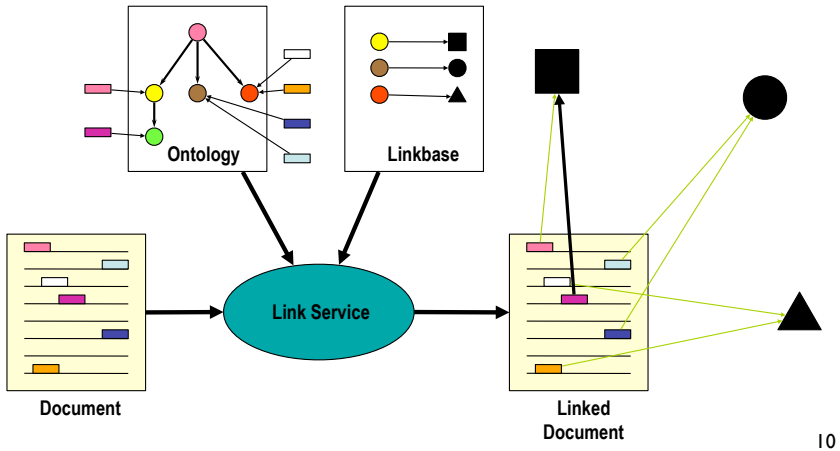
Generic Links + Thesaurus

- A thesaurus can bridge gaps between terms.



Generic Links + Ontology

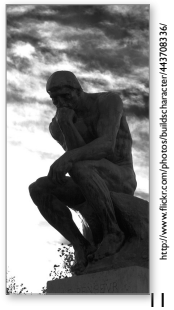
- An ontology can bridge gaps between concepts.



Reflection

- Our original approach involved the use of OWL ontologies to support the conceptual models.
- Over time, we came to see this as a "mistake" -- looser vocabularies were perhaps more appropriate.
- The timely appearance of SKOS….

S. Bechhofer, Y. Yesilada, R. Stevens, S. Jupp, and B. Horan. **Using Ontologies and Vocabularies for Dynamic Linking** *IEEE Internet Computing* 12(3), p. 32--39 2008 http://dx.doi.org/10.1109/MIC.2008.68



http://www.flickr.com/photos/buddecharacter/4437088336/

SKOS

- **SKOS**: Simple Knowledge Organisation Scheme
- Used to represent term lists, controlled vocabularies and thesauri
- Lexical labelling
- Simple broader/narrower hierarchies (with no formal semantics)
- W3C Recommendation

MANCHESTER 1824
The University of Manchester

Primary Use Cases/Scenarios

A. **Single** controlled vocabulary used to **index** and then **retrieve** objects
   - Query/retrieval may make use of some structure in the vocabulary
B. **Different** controlled vocabularies used to **index** and **retrieve** objects
   - Mappings required between the vocabularies

- Also other possible uses (e.g. navigation)

MANCHESTER 1824
The University of Manchester

SKOS Goals

- to provide a **simple, machine-understandable, representation framework** for Knowledge Organisation Systems (KOS)…
- that has the **flexibility** and **extensibility** to cope with the **variation** found in KOS idioms…
- that is fully capable of supporting the **publication** and **use** of KOS within a **decentralised, distributed, information environment** such as the world wide (semantic) web.

SKOS

- A model for expressing basic structure of "**concept schemes**"
- Thesauri, classification schemes, taxonomies and other controlled vocabularies
  - Many of these already exist and are in use in cultural heritage, library sciences, medicine etc.
  - A wide range of knowledge sources that can potentially provide value for Semantic Web applications
- SKOS aims to provide an RDF vocabulary for the representation of such schemes.
  - A migration path bringing such resources "into the Semantic Web".

Concept Schemes

- A concept scheme is a set of concepts, potentially including statements about relationships between those concepts
  - Semantic Relationships
    - Broader/Narrower Terms
    - Related Terms
  - Lexical Labels
    - Preferred, alternative and hidden labels
  - Additional documentation
    - Notes, comments, descriptions

Knowledge Organisation

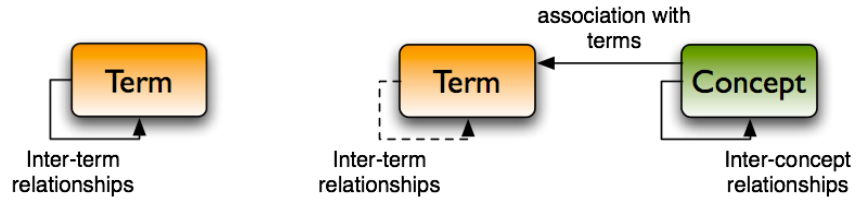
Thesaurus: Controlled vocabulary in which concepts are represented by preferred terms, formally organised so that paradigmatic relationships between the concepts are made explicit, and the preferred terms are accompanied by lead-in entries for synonyms or quasi-synonyms.

Thesaurus	Related Terms
Taxonomy	Hierarchy
Authority File	Preferred Terms
Synonym Ring	Equivalent Terms
Controlled Vocabulary	Collection of Terms

Controlled vocabularies: designed for use in classifying or indexing documents and for searching them.

Term Based vs Concept Based

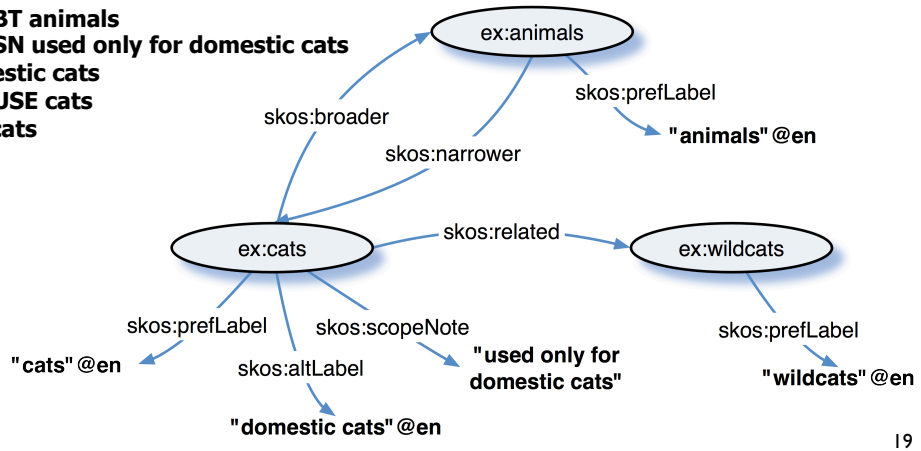
- SKOS adopts a concept-based (as opposed to term-based) approach



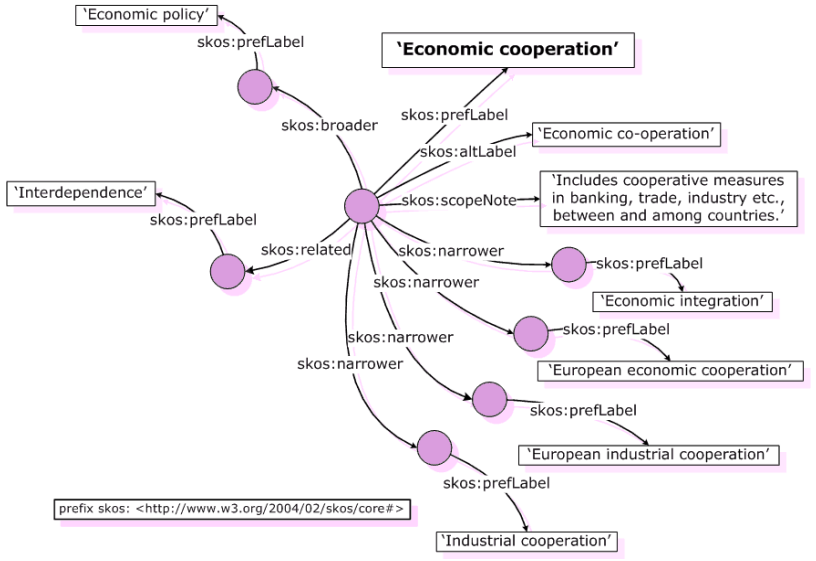
- Concepts associated with lexical labels
- Relationships expressed between concepts.
  - Possibility of expressing relationships between terms through SKOS-XL.

SKOS Example

animals
NT cats
cats
UF domestic cats
RT wildcats
BT animals
SN used only for domestic cats
domestic cats
USE cats
wildcats



SKOS Example



SKOS Semantic Relations

- Hierarchical and Associative
- Broader/Narrower
- Loose (i.e. no) semantics
  - A publishing vehicle, not a set of thesaurus construction guidelines
- Domain/Range restrictions on semantic relations
- Broader/Narrower not transitive in SKOS
  - But transitive super property
  - Recall partonomic discussions!

SKOS and OWL

- SKOS and OWL are intended for different (but related) purposes
- SKOS Concept schemes are not formal ontologies in the way that, e.g. OWL ontologies are formal ontologies.
- There is no formal semantics given for the conceptual hierarchies (broader/narrower)represented in SKOS.
- Contrast with OWL subclass hierarchies which have a formal interpretation (in terms of sets of instances).

- A weaker *ontological commitment*.

Ontological Commitment

> An ontology should require the minimal ontological commitment sufficient to support the intended knowledge sharing activities. An ontology should make as few claims as possible about the world being modeled, allowing the parties committed to the ontology freedom to specialize and instantiate the ontology as needed.
>
> Gruber

- SKOS captures the basic, informal semantics most commonly required by the use cases.

SKOS and OWL

- SKOS Concepts not intended for instantiation in the same way that OWL Classes are instantiated
  - Leo is an *instance* of Lion
  - Born Free is a book *about* Lions
- Concept Schemes allow us to capture general statements about things that aren't necessarily strictly true of everything
  - It's useful to be able to navigate from Cell to Nucleus, even though it's not the case that all Cells have a Nucleus
  - Relationships between Polio and Polio virus, Polio vaccine, Polio disease…
  - Relationships between Accident and Accident Prevention, Accidents in the Home, Radiation Accidents…
- But we *can't* necessarily draw the same kinds of *inferences* about SKOS hierarchies.
  - Broader hierarchy is not transitive.
    - Although mechanisms are available which allow us to query the transitive closure of the hierarchy.

MANCHESTER 1824
The University of Manchester

SKOS and OWL

- SKOS itself is defined as an OWL ontology.
- A particular SKOS vocabulary is an instantiation of that ontology/schema
  - E.g. SKOS Concept is a Class, particular concepts are instances of that class
- Allows us to use some of the mechanisms of OWL to define properties of SKOS (e.g. the querying of the transitive closure of broader).
- Allows us to use generic tooling to construct/maintain our vocabularies

MANCHESTER 1824
The University of Manchester

Annotation in OWL

- OWL data and object properties allow us to define the characteristics of classes
  - Necessary/sufficient conditions etc.
  - Model theory/semantics provides interpretations of the assertions involving the properties
- Ontology engineering (and use) also requires *annotation*
  - Decoration of concepts/properties/individuals with information which is useful, but does not impact on the formal semantics or logical interpretations
- Separation of the concept from its concrete label is usually seen as a Good Thing.

Annotation

- Annotations do not impact on the formal semantics or logical interpretations
- Thus they are "opaque" to a reasoner.
- But still useful for both humans and application

General

- Labels
  - Human readable
- Textual Definitions
  - Scope notes
- DC style metadata
  - authorship
- Change History
- Provenance information

Application Specific

- Entry points for forms
- Driving User interaction
- Syntax round-tripping
- Hiding engineering aspects of the model
- Methodological support, e.g. OntoClean

SKOS as Annotation

- SKOS labelling and documentation properties are defined as OWL Annotation Properties
  - Preferred/Alternate/Hidden Labels
  - Documentation/Notes

- SKOS then provides a standardised vocabulary for annotating OWL ontologies
- Leverage existing tooling.
  - OWL API
  - Protégé

SKOS and OWL

- SKOS and OWL are intended for different purposes.
- OWL allows the explicit modelling/description of a domain
- SKOS provides vocabulary and navigational structure

- Interaction between representations is ongoing work.
  - Presenting OWL ontologies as SKOS vocabularies
    - Principled "dumbing down"
  - Enriching SKOS vocabularies as OWL ontologies.
    - How to handle "related"
  - Use of SKOS as annotation vocabulary

Mapping Concept Schemes

- SKOS also provides a collection of *mapping properties* that express relationships between concepts in different schemes
  - broadMatch/narrowMatch
  - closeMatch
  - exactMatch
- Support alignment of different concept schemes
  - Indiscriminate use of properties such as owl:sameAs can lead to undesirable consequences.

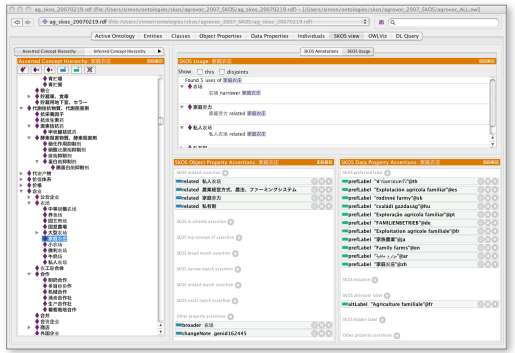
SKOS and Linked Data

- Linked Data standardised "guidelines" for publishing data
  - URIs for identification
  - Provide useful information when dereferenced
  - Link to other URIs
- SKOS as lightweight semantics for LD
- Facilitating publication of existing KOS/data.
- Mapping relationships

SKOS	LD
Indexing/Retrieval	Discovery
Semantic Relations	Navigation
Mapping	Linking and Integration beyond URI matching

Tooling: SKOSEd

- Editor supporting construction of SKOS vocabularies
- "Native" SKOS implementation
  - Protégé 4 plugin exploiting OWL definition of SKOS vocabulary
  - Reasoning support for classification
- Lexical labelling
  - Alternate language support
- Extension points for domain relationships



Examples

- IVOA Astronomy thesauri:
  - e.g. http://www.ivoa.net/rdf/Vocabularies/vocabularies-20091007/IVOAT/dict/B.html#blackHole
- AGROVOC (FAO)
  - e.g. http://aims.fao.org/aos/agrovoc/c_12332.html
- E-Culture
  - Europeana: https://www.europeana.eu/
  - Finnish Library Services: http://onki.fi/
- LCSH
  - Library of Congress: http://id.loc.gov
- NASA, IPSV, BBC, etc.

Resources

- SKOS:
  - http://www.w3.org/TR/skos-reference/
  - http://www.w3.org/TR/skos-primer/
  - http://www.w3.org/TR/skos-ucr/
- Baker et al. *Key choices in the design of Simple Knowledge Organization System (SKOS)*
  - https://doi.org/10.1016/j.websem.2013.05.001