BestMap: Context-Aware SKOS Vocabulary Mappings in OWL 2

Rinke Hoekstra
Overview

• Use Case
  – Access to court proceedings
• Vocabulary Mapping
• Requirements
• BestMap
• Discussion
BestPortal

• BEST Project
  – “BATNA Establishment using Semantic Web Technology”
  – Best Alternative to a Negotiated Agreement

• Improve access to court proceedings
  – Netherlands Council of the Judiciary
    http://www.rechtspraak.nl
  – 50 thousand verdicts
“Does my case stand a chance in court?”

• Full text search is not enough
  – Laymen
  – Lawyers

• Lawyers have their own language: *legalese*
  – Bridge the gap between common sense and legal knowledge

• Knowledge-based solution too expensive
  – Modelling effort
  – Quality assurance
  – Legal theory: *definitions*
BestPortal: Requirements

• Translate **layman** description to **legal** terms

• Search using **fingerprints** of **legal** terms

• **Context** in which **layman** concepts co-occur in a case determines the applicability of a **legal** concept

• A mapping is **not** the definition of a concept
Vocabularies

• Cultural Heritage
  – Museums, libraries
  – Huge repositories of (rich) information
  – Annotated using many different vocabularies (knowledge organization systems)

• Concept-based information retrieval
  – Europeana portal (http://www.europeana.eu)
Why Vocabulary Mapping

• Integrated access? Vocabulary mapping!
  – Format (XML to RDF)
    • e.g. via XSLT one-way transformation
  – Structure (VCard:Given + VCard:Family to foaf:name)
    • e.g. via SPARQL++, one-way transformation
  – Concepts (foaf:Person to lkif:Person)

• Simple Knowledge Organization System (SKOS)
  – Lifting existing KOS’s to the Semantic Web
  – Every skos:Concept is an OWL individual
  – Lightweight semantic relations: broader, narrower, and related.
  – Lightweight mapping relations between skos:ConceptSchemes.
Europeana Datacloud
Mapping in SKOS

- skos:semanticRelation
- skos:narrower
- skos:related
- skos:narrowMatch
- skos:relatedMatch (symmetric)
- skos:closeMatch (symmetric)
- skos:exactMatch (symmetric, transitive)
- skos:broadMatch
- skos:broader
- skos:mappingRelation
- skos:related
- inverse
- disjoint
Information retrieval perspective vs. lightweight semantics

• No **many-to-many** mappings
  – Mapping only between *pairs* of concepts
  – Required for *re-indexing* and *search* across collections (Isaac et al. 2007)

• ... fundamental issue
  – SKOS concepts and relations are ‘intensional’
  – What does a mapping then *mean*?

• Implicit assumption of **extensionality**
Extensional View

• SKOS relations
  – “Resources annotated by some concept should be retrievable via its broader concept.”

• SKOS mappings
  – “Resources annotated by some concept should be retrievable via the concepts it is mapped to.”

• ... only means to assess quality
BestMap: Requirements

• Extensional perspective
  – Concepts as **annotations** on resources
• Compatibility
  – Integrated with SKOS
• Hierarchic mappings
  – Exploit `skos:broader` and `skos:narrower`
• Many-to-many mappings
  – Granularity
  – **Context** determines whether a mapping holds
• Flexible and Lightweight
  – A mapping is **not** the definition of a concept
Connecting to SKOS (1)

- Relation between :Resource and skos:Concept
  \[ :about \equiv inv( :describes) \]
- Direct and indirect annotations
  \[ :d\_about \subseteq :about \]
  \[ :d\_describes \subseteq :describes \]
  \[ :d\_describes \equiv inv( :d\_about) \]
Connecting to SKOS (2)

• Transitive broader/narrower

:about $\circ$ skos:broaderTransitive $\subseteq$ :bt_about

:about $\circ$ skos:narrowerTransitive $\subseteq$ :nt_about

• Similar for other SKOS relations
Connecting to SKOS (3)
Mappings as OWL Classes

• A **mapping** class:
  – *Classifies* resources annotated using one vocabulary, and
  – *Infers* annotations using the other vocabulary
  – ... it may be **directed**

\[
\text{ex:AO\_Mapping} \equiv \text{:about value lv:animal} \sqsubseteq \text{:about value lv:company} \sqsubseteq \\
\text{:about value lv:dangerous\_action} \sqsubseteq \text{:d\_about value tv:animal} \sqsubseteq \text{:d\_about value tv:animal\_owner} \sqsubseteq \\
\text{:d\_about value tv:damage}
\]
Example
Discussion

• Extensible
  – Any OWL axiom may be used in a mapping (e.g. someValuesFrom etc.)
  – Reusable (partial) mappings
  – Exclude resources annotated with a particular concept
    • Negative property assertions
• Novel
  – “Reification” wrt. normal OWL ontologies
• Overcomes limitations of SKOS semantics
  – Makes explicit the extensional perspective that underlies SKOS semantics
  – Non-intrusive
Discussion

• OWL 1 vs OWL 2
  – Property chains
  – Disjoint properties
  – Negative property assertions

• The bad
  – Cannot enforce that the mapping holds between two distinct concept schemes
  – Property chains are not equivalent to super property
Future Work

• Apply BestMap to other domains
  – Legal assessment based on spatial plans
  – ...

• Further development of BestPortal
  – Do the mappings actually work?
  – Structured mappings
    • (case frames)
  – Does BestPortal really improve access to court proceedings?
  – Connect to the linked data cloud