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GenTax: A Generic Methodology for Deriving OWL and RDF-S Ontologies from Hierarchical Classifications, Thesauri, and Inconsistent Taxonomies

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Goal: Derive OWL and RDF-S ontologies from any hierachical classification

- Being able to derive consistent RDF-S,OWL, and WSML ontologies from hierarchical classifications
- High degree of automation, i.e., without the need for manual analysis of conceptual elements
- Ability to transform SKOS vocabularies into RDF-S, OWL, or WSML

Motivation: Hierarchical classifications as a major resource

- Hierarchical classification systems are a major resource for structuring information
- Well established means in information management
- However, reuse for building ontologies not trivial
  - Fuzzy notion of class membership
  - Context-dependent semantics

Assets for the Semantic Web: A Wealth of Consensual Concepts

- **UNSPSC,** http://www.unspsc.org
  - 20,700 classes, 55 top-level categories
- **eCl@ss,** http://www.eclass.de
  - 25,000 classes, 25 top-level categories
- **eOTD, http://**www.eotd.org
  - 59,000 classes, 79 top-level categories

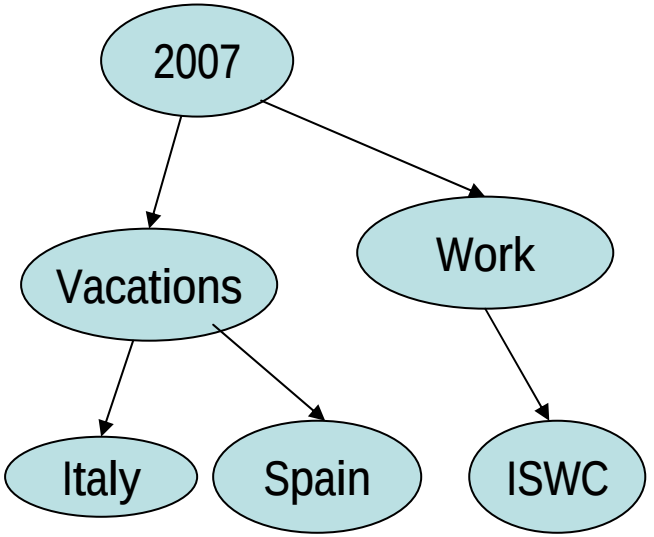
- DMOZ
- Wikipedia Categories

etc.

Definition: Hierarchical classifications

We view a **hierarchical categorization schema** as

- **a directed graph**
- where **nodes represent categories** and
- **edges represents the "narrower term"** or "has subcategory" relation.
- Depending on the **context**, a set is related to each category.
- This set represents the **items associated with the category in a particular context.**



Observations

- Classifications do not require a context independent definition of their intended meaning
  - We can use the same classification in multiple distinct contexts with very different meanings, as long as we keep the contexts apart
    - Invoices vs. Documents vs. Tasks
- When we use the labels as definitions for sets, we interprete them over the context of usage
- The meaning of a label and the meaning of the edges are mutually dependent
- We may face several anomalies

Anomalies

- **Local labels**
  - Pictures->Italy->Summer 2006
  - Pictures-> Pictures.Italy -> Pictures.Italy.Summer_2006
- **Hierarchy:** Depending on the context over which we interprete a label, the original set of arcs
  - **may** or
  - **may not**

  constitute a valid subsumption hierarchy

1

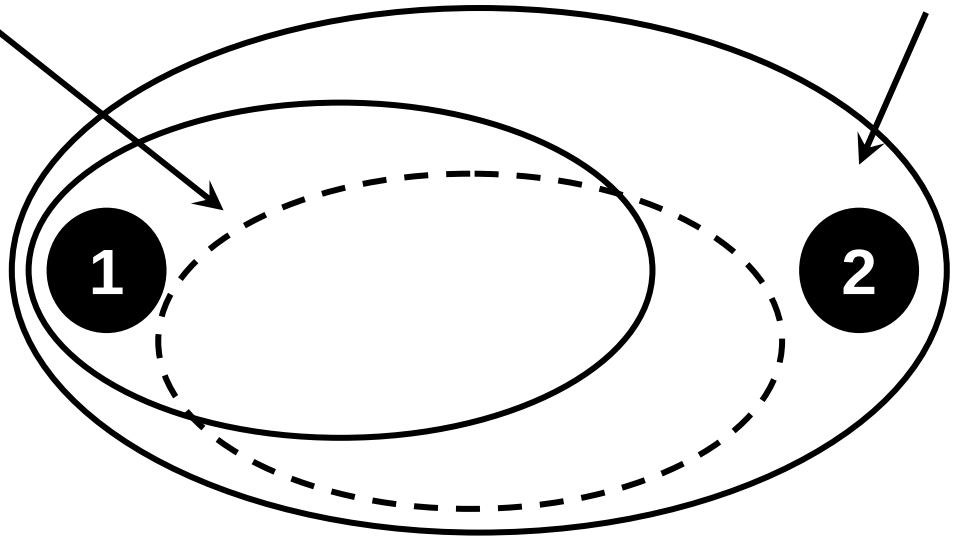
Concept in some context

(Example: "*Pictures of* Italy")

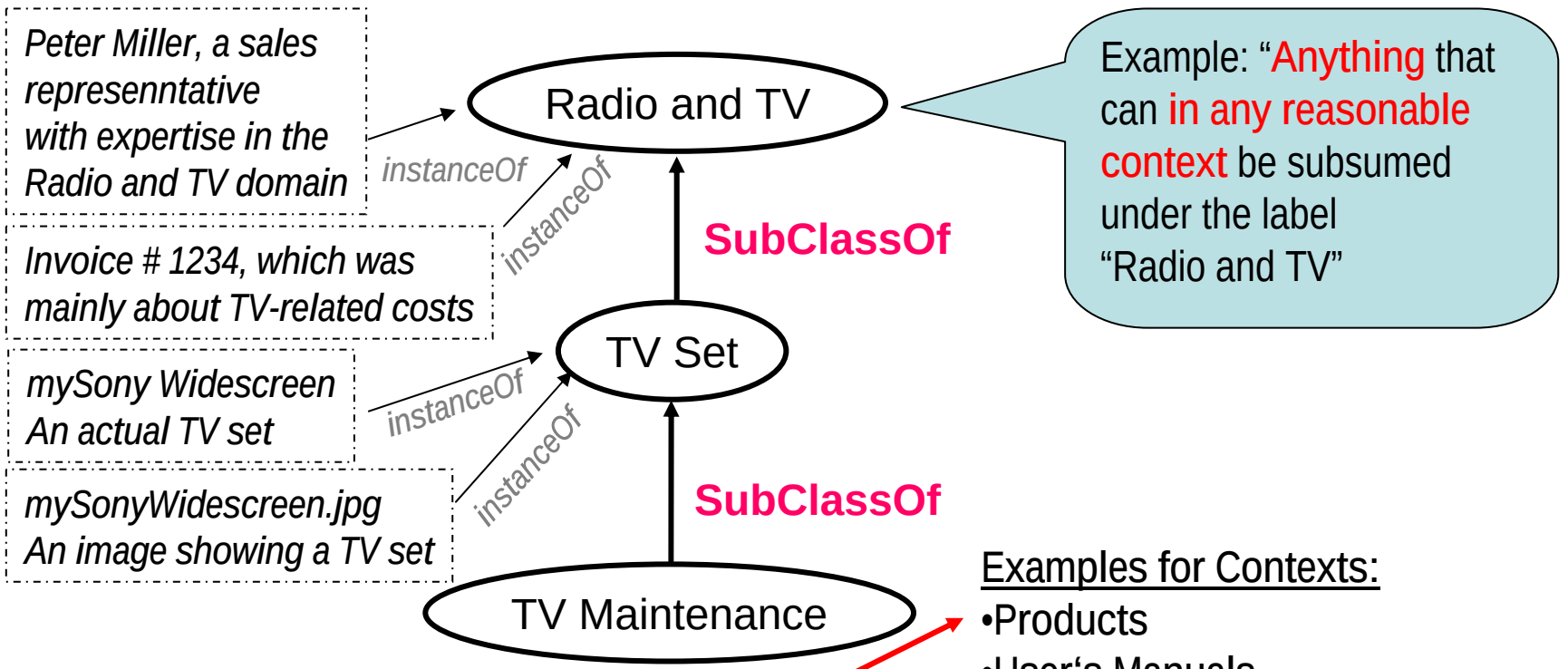
2

Category Concept

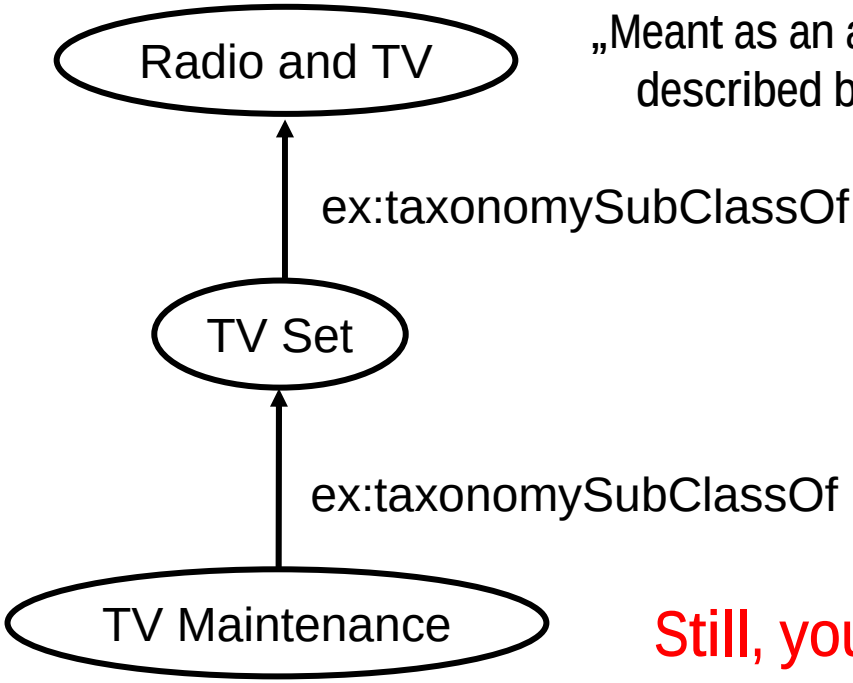
(Example: "**Anything** that can **in any reasonable context** be subsumed under the label "Pictures.Italy")



Naïve Approach: One ontology class per each label (leads to ontologies limited in use)



Solution 1:One class for each node in the target context (but impossible in OWL)

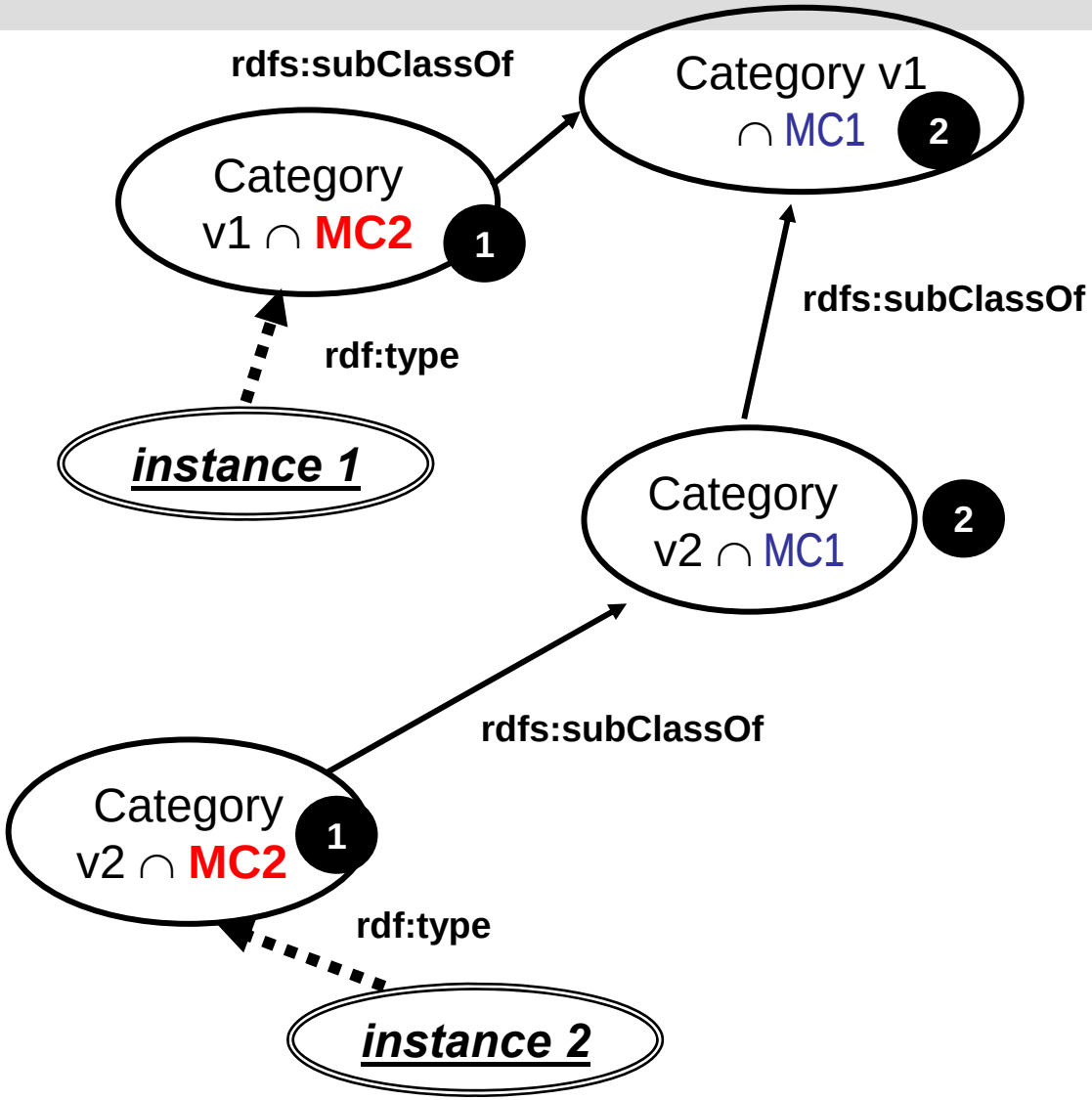


Still, you have to select one target context!

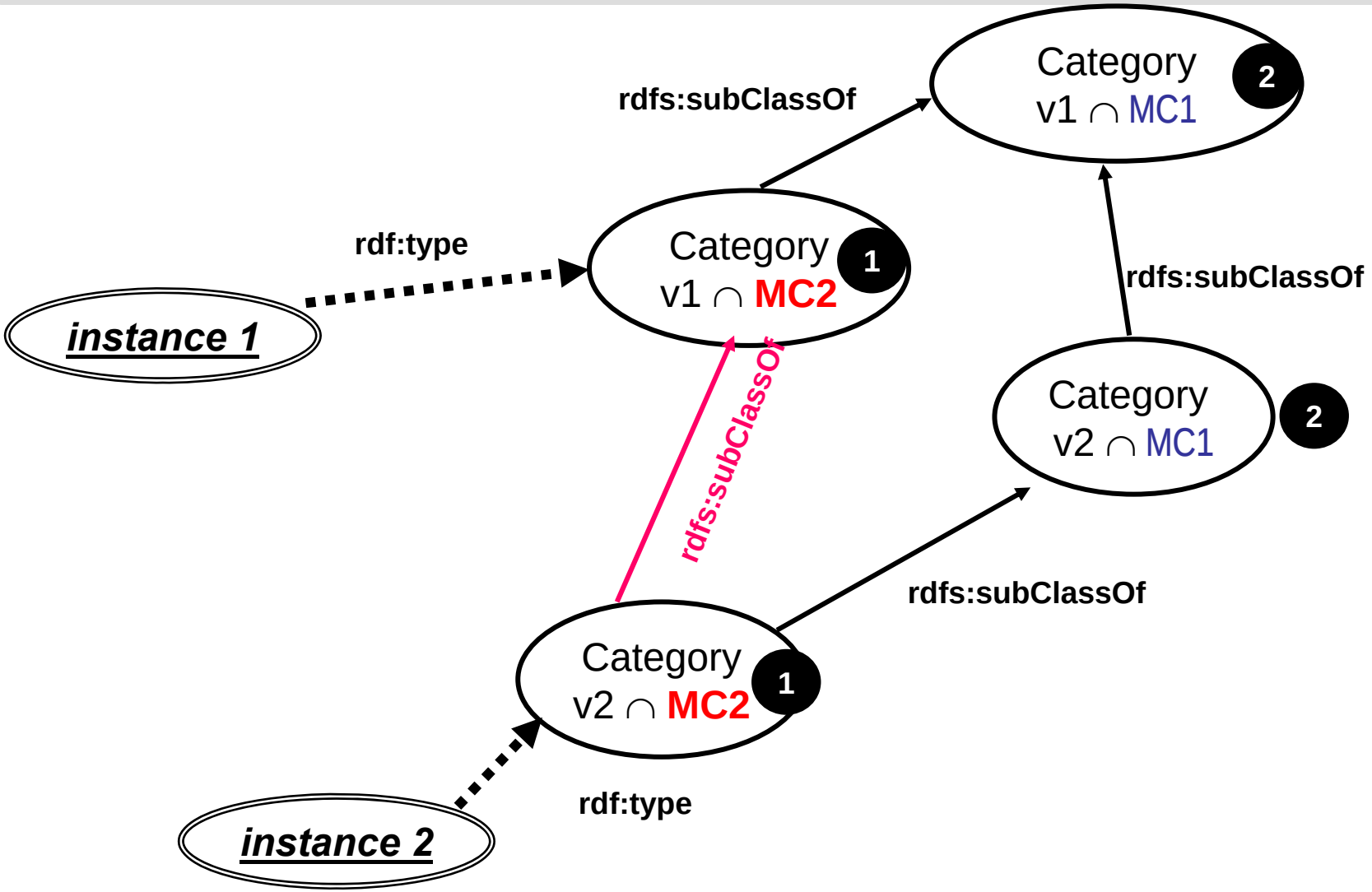
FORALL
A ex:taxonomySubClassOf B AND
B ex:taxonomySubClassOf C
→ A ex:taxonomySubClassOf C

The GenTax Idea

1. Define two Master Concepts:
   a) MC1 – any item for which the orginal hierarchy was intended.
   b) MC2 – the set of all entities in the target context
2. Check whether the orginal hierarchy is a valid subsumption hierarchy if you interprete the categories as label ∩ MC1
3. Check whether each label ∩ MC2 is a proper subclass of this label ∩ MC1
4. For steps 3 and 4, we take representative samples only!



Special (Lucky) Case



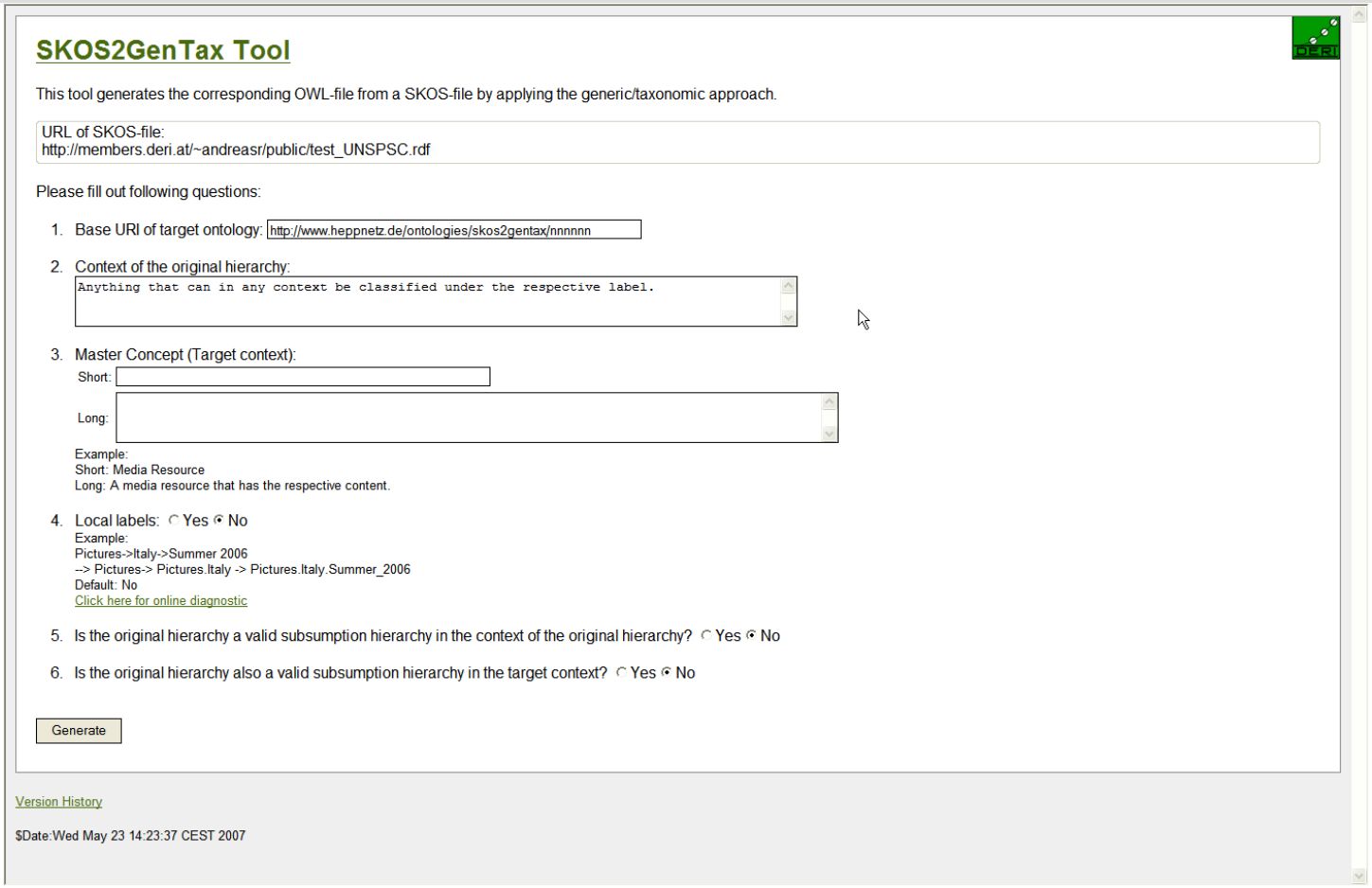
Nice Properties

- Automatic creation of lightweight ontologies possible that require only subClassOf as a modeling element
  - Resulting ontologies can be expressed in most popular ontology languages
- Original hierarchy can be preserved while still being able to design more specific ontology classes for each label
- Only a small sample necessary to decide upon proper conceptual modeling
  - No need to manually analyze each single element of large classifications

Statistical Diagnosis of Anomalies and Modeling Choices

- Idea
  - We draw a representative sample of the input classification
  - We ask a human to decide for this small sample whether for this element certain modeling choices are correct
    - e.g. whether, as categories for expenses, TV maintenance is a subclass of TV Set
    - same for local labels and other anomalies
  - We accept or reject that modeling choice for the full classification based on the sample
- Advantages
  - We have a solid statistical basis for the decision
  - We can chose a suitable degree of confidence depending on the target domain of the ontology
    - classifying Web documents vs. life sciences

Tooling: SKOS2GenTax Converter



SKOS2GenTax Tool

This tool generates the corresponding OWL-file from a SKOS-file by applying the generic/taxonomic approach.

URL of SKOS-file:
http://members.deri.at/~andreasr/public/test_UNSPSC.rdf

Please fill out following questions:

1. Base URI of target ontology: http://www.heppnetz.de/ontologies/skos2gentax/nnnnnn
2. Context of the original hierarchy:
   Anything that can in any context be classified under the respective label.
3. Master Concept (Target context):
   Short:
   Long:
   Example:
   Short: Media Resource
   Long: A media resource that has the respective content.
4. Local labels: ○ Yes ◉ No
   Example:
   Pictures->Italy->Summer 2006
   --> Pictures-> Pictures.Italy -> Pictures.Italy.Summer_2006
   Default: No
   Click here for online diagnostic
5. Is the original hierarchy a valid subsumption hierarchy in the context of the original hierarchy? ○ Yes ◉ No
6. Is the original hierarchy also a valid subsumption hierarchy in the target context? ○ Yes ◉ No

Generate

Version History

$Date:Wed May 23 14:23:37 CEST 2007

Will be online shortly at http://www.heppnetz.de/skos2gentax/

Martin Hepp, Jos de Bruijn: *GenTax: A Generic Methodology for Deriving OWL and RDF-S Ontologies from Hierarchical Classifications, Thesauri, and Inconsistent Taxonomies,* Proceedings of the 4th European Semantic Web Conference (ESWC 2007), June 3-7, Innsbruck, Austria, in: E. Fraconi, M. Kifer, and W. May (Eds.): ESWC 2007, LNCS 4519, Springer 2007, pp.129-144.

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Thank you.

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