Support of SKOS Vocabularies in Digital Repository Systems –The Case of the University of Patras Institutional Repository

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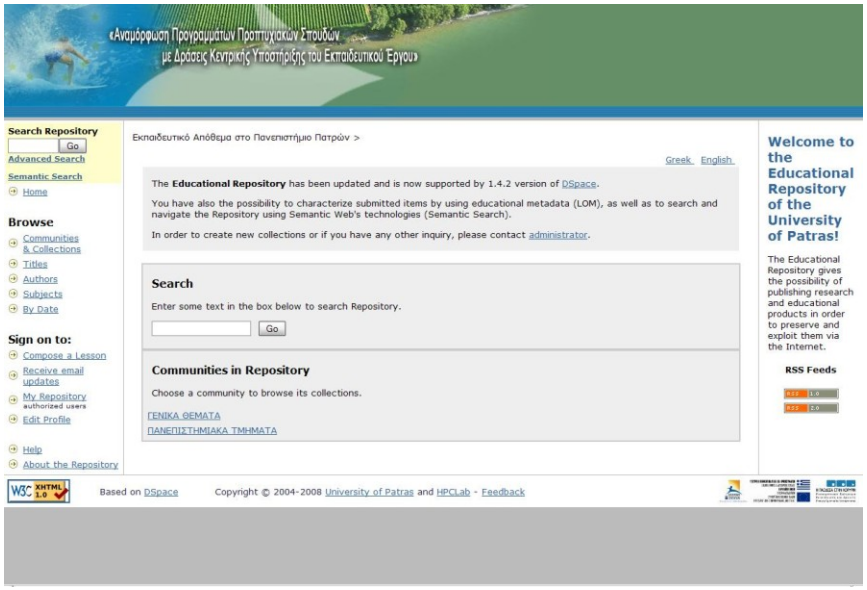
University of Patras Institutional Repository

A mechanism for the efficient **description**, **preservation, management**, **exploitation** and **distribution** of the University's educational and scientific material



http://repository.upatras.gr/dspace

- Built upon the open-source **DSpace** digital repository system
- Item description using the **Dublin Core** metadata schema

Articles, Books, Theses, Journal Papers, Images, Videos, Learning Objects, Data Sets, …

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University of Patras Institutional Repository

Additional features

- Multilingual support
  - User Interface (Greek, English, …)
  - Metadata - Characterization of items in more than one languages
- Advanced search service
  - Full text
  - Metadata
  - **Semantic Search**
- Advanced browsing
  - Semantic navigation

Controlled Vocabularies in DSpace

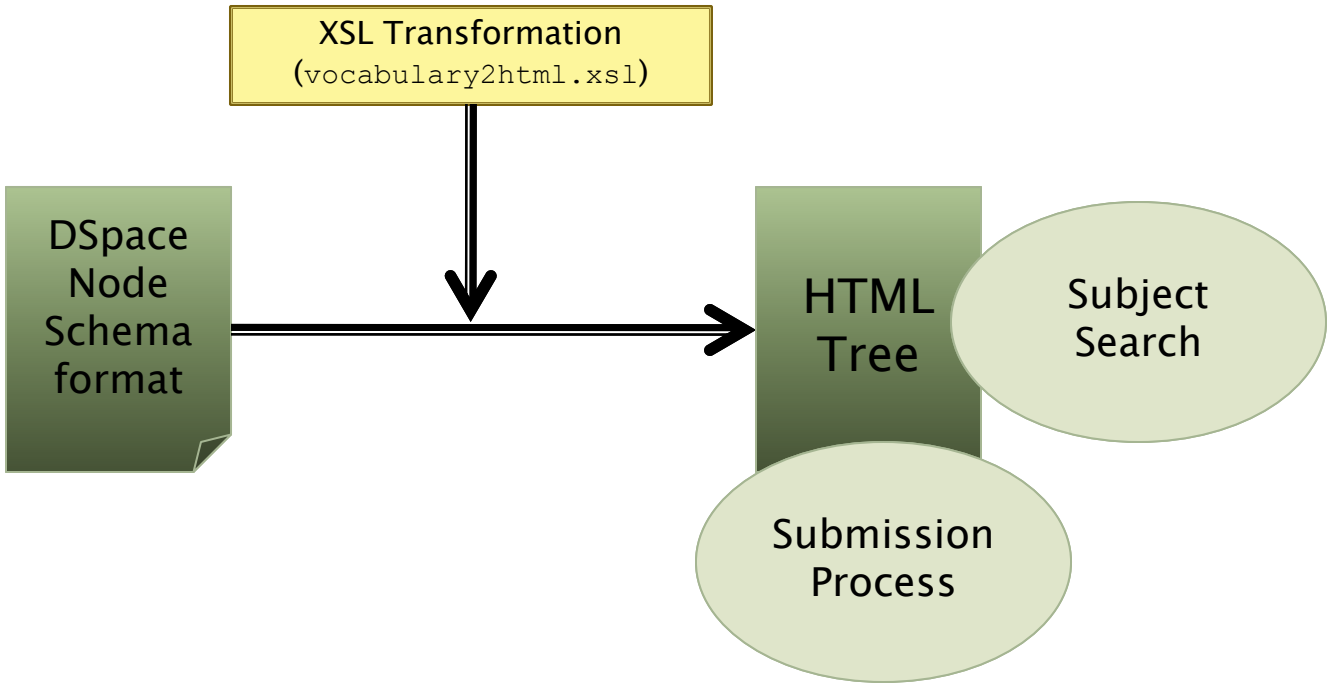
- Support of Controlled Vocabularies expressed in XML format (*"Node Schema"*)

DSpace Node Schema

```
<node id="acmccs98" label="ACMCCS98">
  <isComposedBy>
    <node id="A." label="General Literature">
      <isComposedBy>
        <node id="A.0" label="GENERAL"/>
        <node id="A.1" label="INTRODUCTORY AND SURVEY"/>
       …
  </isComposedBy>
</node>
```

  - Each term is represented as a `<node>`, characterized by a unique **ID** and a lexical **Label**
  - `<isComposedBy>` is used for narrower relationships

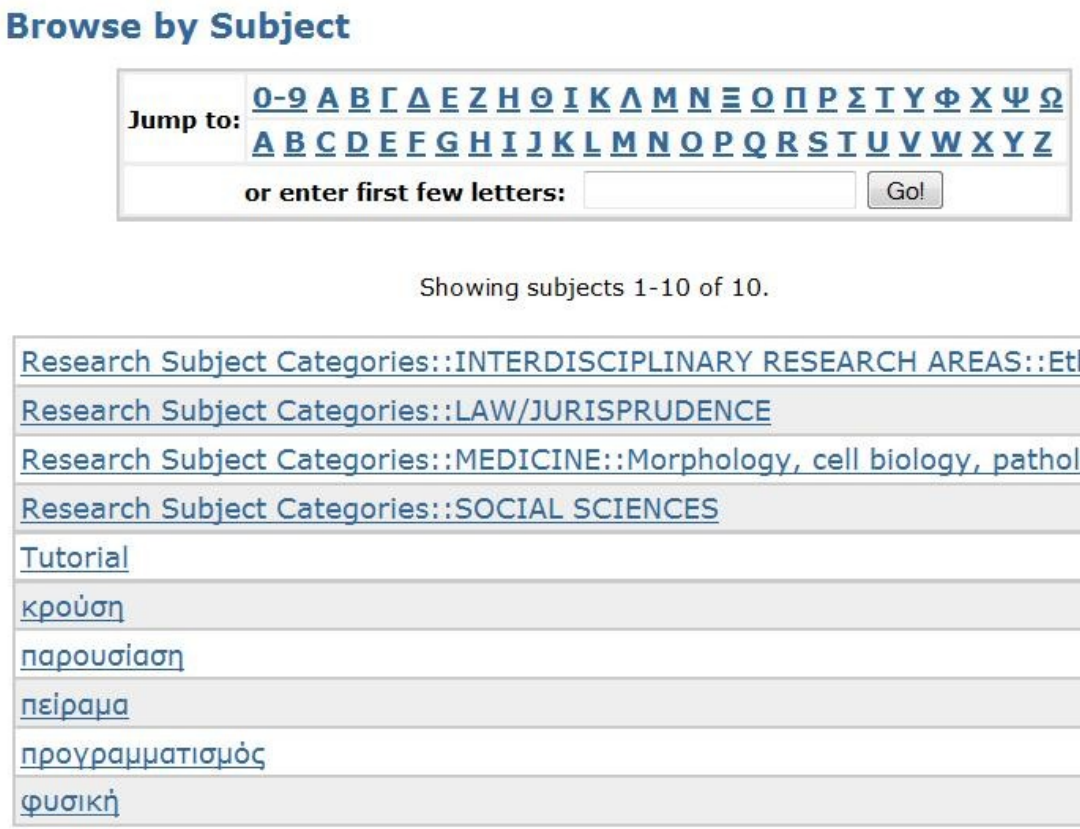
Vocabulary Ingestion Process



Controlled Vocabularies in DSpace

- Usage
  - Refinement of the set of keywords used:
    - during item description in the **submission process**
    - when **browsing** by subject
  - **Search** in subject fields

Browse by Subject



Browse by Subject

Jump to: 0-9 A B Γ Δ E Z H Θ I K Λ M N Ξ O Π P Σ T Y Φ X Ψ Ω
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

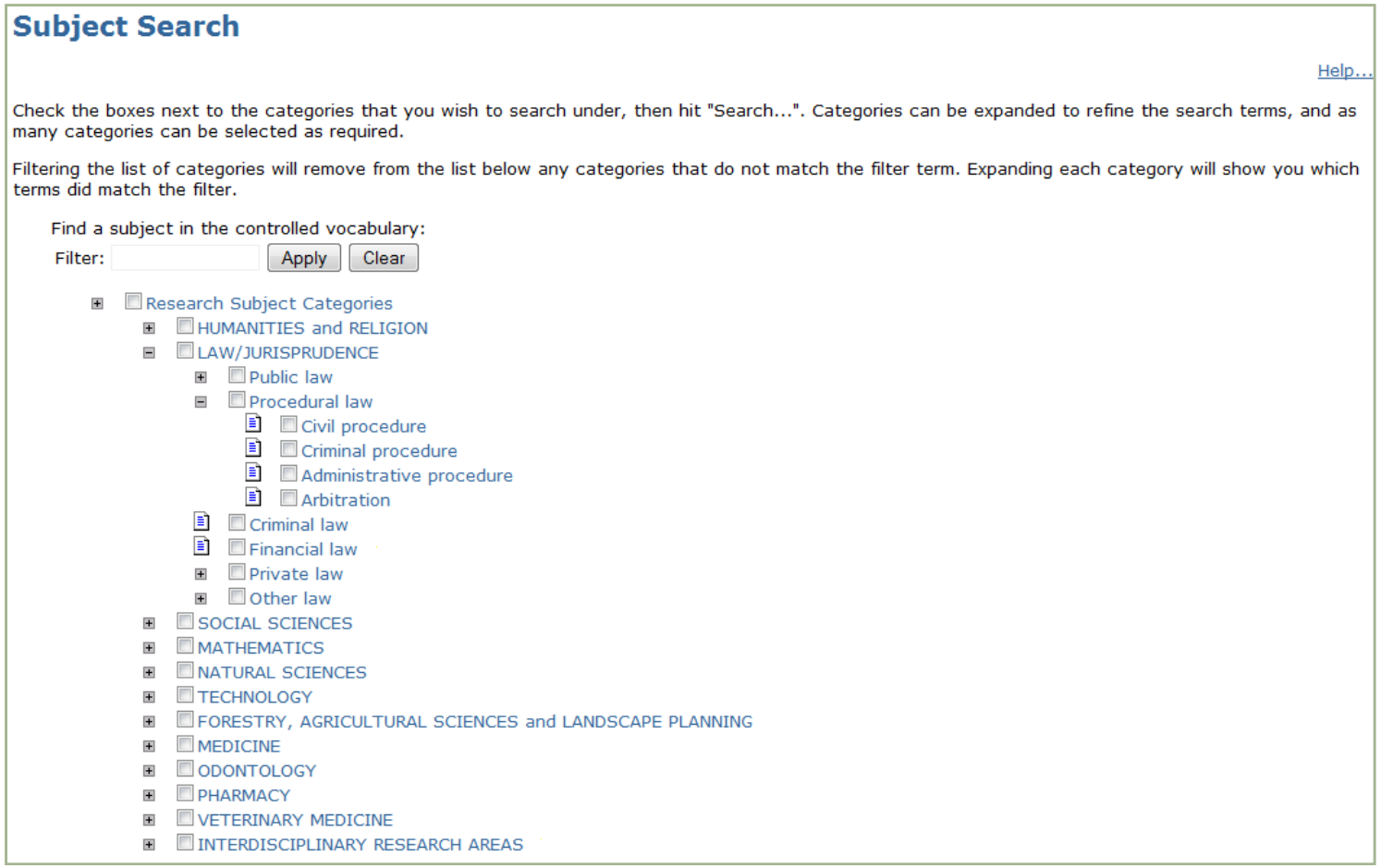
or enter first few letters: Go!

Showing subjects 1-10 of 10.

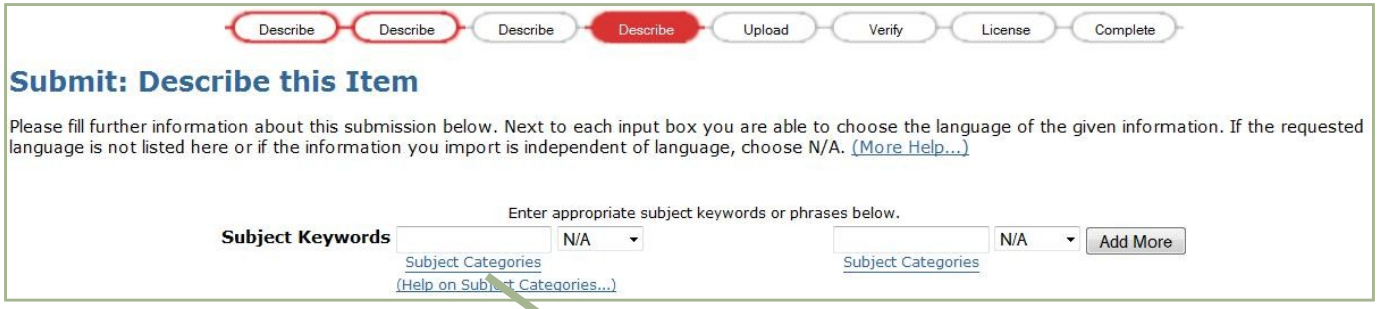
- Research Subject Categories::INTERDISCIPLINARY RESEARCH AREAS::Ethnicity
- Research Subject Categories::LAW/JURISPRUDENCE
- Research Subject Categories::MEDICINE::Morphology, cell biology, pathology
- Research Subject Categories::SOCIAL SCIENCES
- Tutorial
- κρούση
- παρουσίαση
- πείραμα
- προγραμματισμός
- φυσική

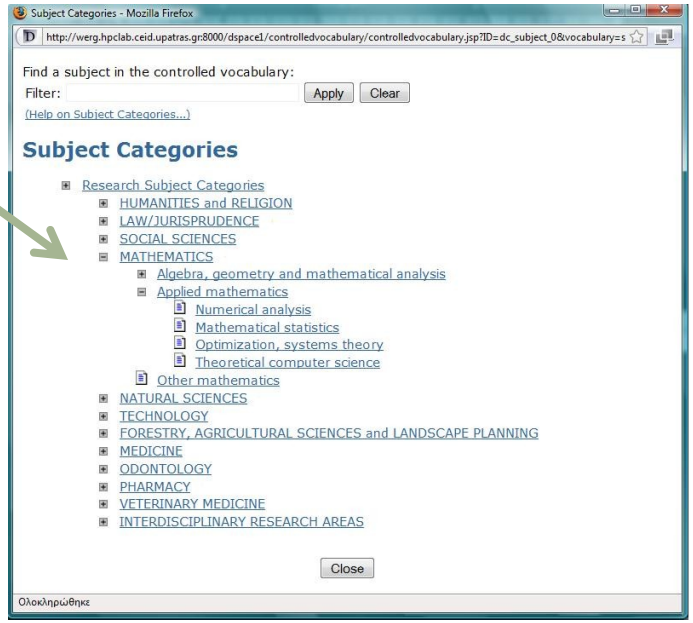
Controlled Vocabulary Terms

Subject Search



Controlled Vocabularies in the Submission Process





- Auto-fill subject field using proposed terms (pop-up window)
- Use of only one controlled vocabulary

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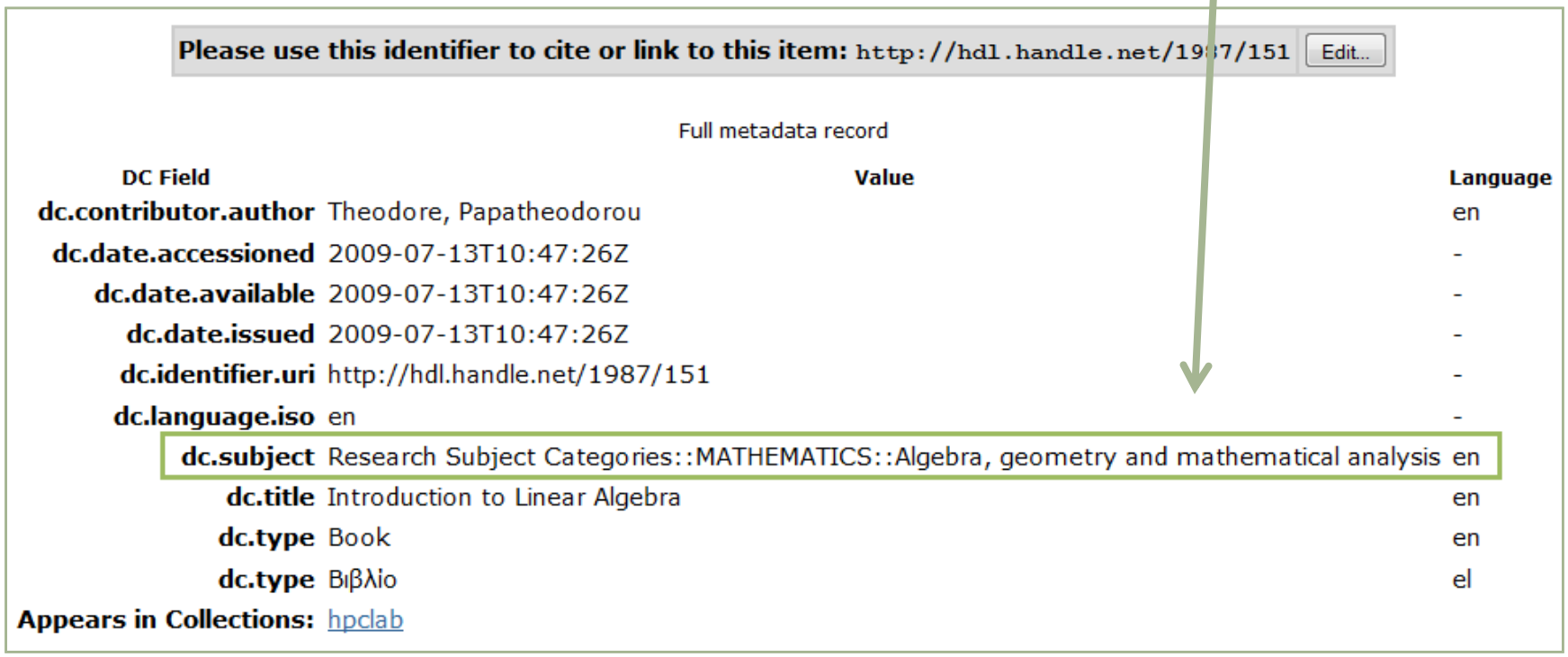
DSpace Item Metadata

Subject coming from the controlled vocabulary terms



Please use this identifier to cite or link to this item: http://hdl.handle.net/1987/151 Edit...

Full metadata record

DC Field	Value	Language
dc.contributor.author	Theodore, Papatheodorou	en
dc.date.accessioned	2009-07-13T10:47:26Z	-
dc.date.available	2009-07-13T10:47:26Z	-
dc.date.issued	2009-07-13T10:47:26Z	-
dc.identifier.uri	http://hdl.handle.net/1987/151	-
dc.language.iso	en	-
dc.subject	Research Subject Categories::MATHEMATICS::Algebra, geometry and mathematical analysis	en
dc.title	Introduction to Linear Algebra	en
dc.type	Book	en
dc.type	Βιβλίο	el
Appears in Collections:	hpclab	

Item's Metadata

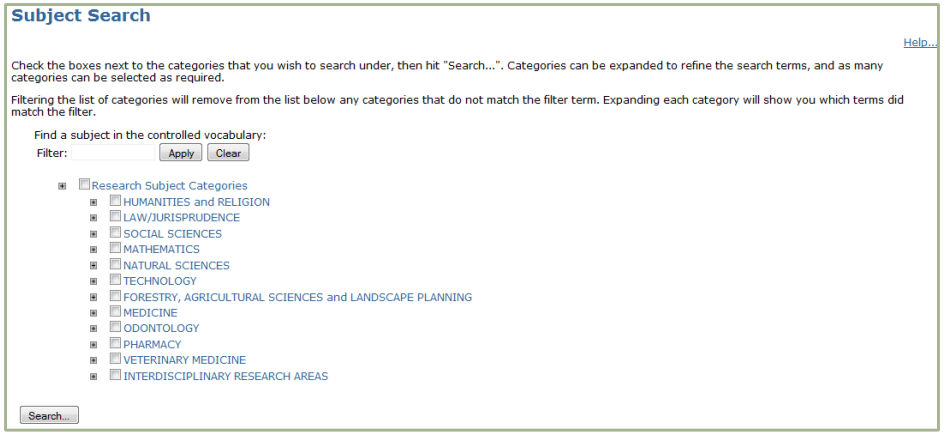
Controlled Vocabularies in DSpace

Additional features

- Support for multilingual vocabularies
  - one file for each translation (language)
  - use of the language code in the name of the file (e.g. `voc_el.xml` for Greek)

implemented by HPCLab, University of Patras

Subject Search in Greek Interface



Subject Search in English Interface

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Structure of Controlled Vocabularies in DSpace

- Vocabulary formatted in a simple XML structure ⇨ not a **standard**!
- Only a simple hierarchical (narrower) relationship is expressed
  - `<isComposedBy>`

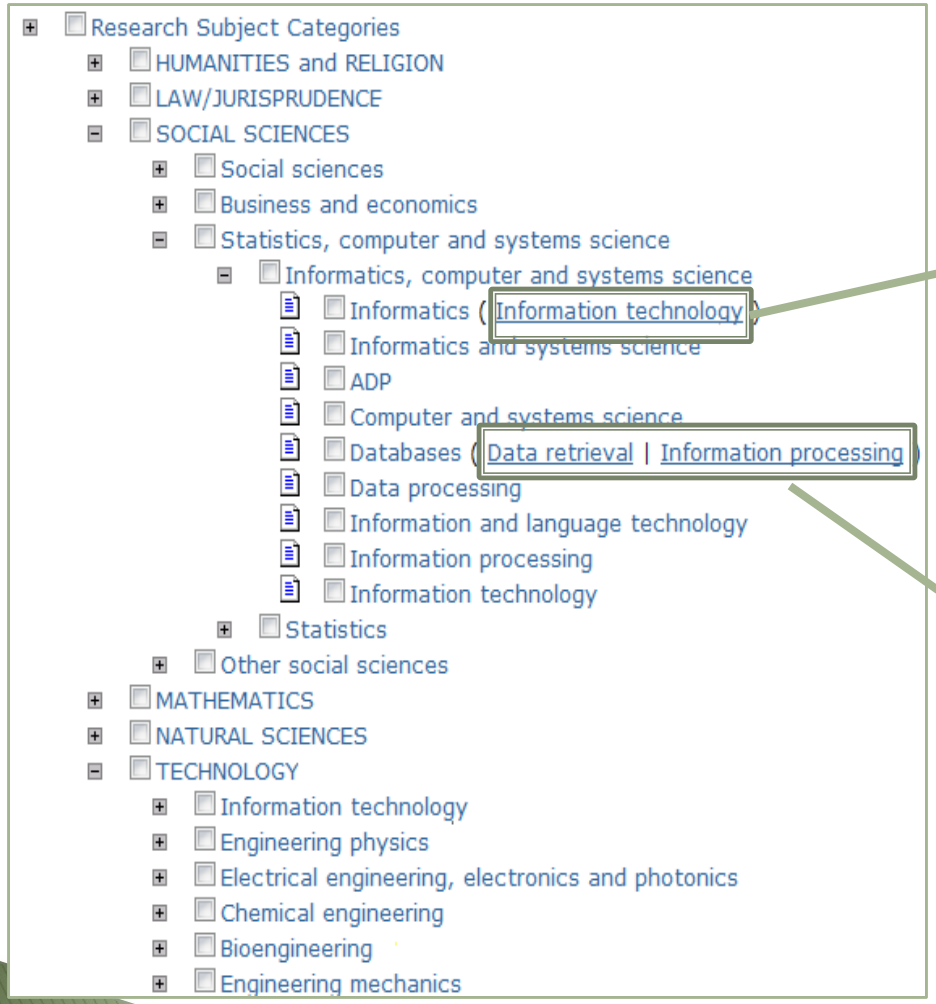
  ⇨ loose type of relationships among terms
- About SKOS
  - very close to becoming a standard
  - provides richer types of relationships
    - Hierarchical (broader/narrower)
    - Associative (related)

Controlled Vocabulary add-on for DSpace

by the Odisseia Research Group at the University of Minho

1. Updated node schema supporting more types of relationships and/or properties
   - Provision for associative relationships (Related Terms)
   - Allows for the use of preferred terms (Use-instead Terms)

Updated Node Schema



Use-instead Term
Use “Information Technology” *instead of* “Informatics”

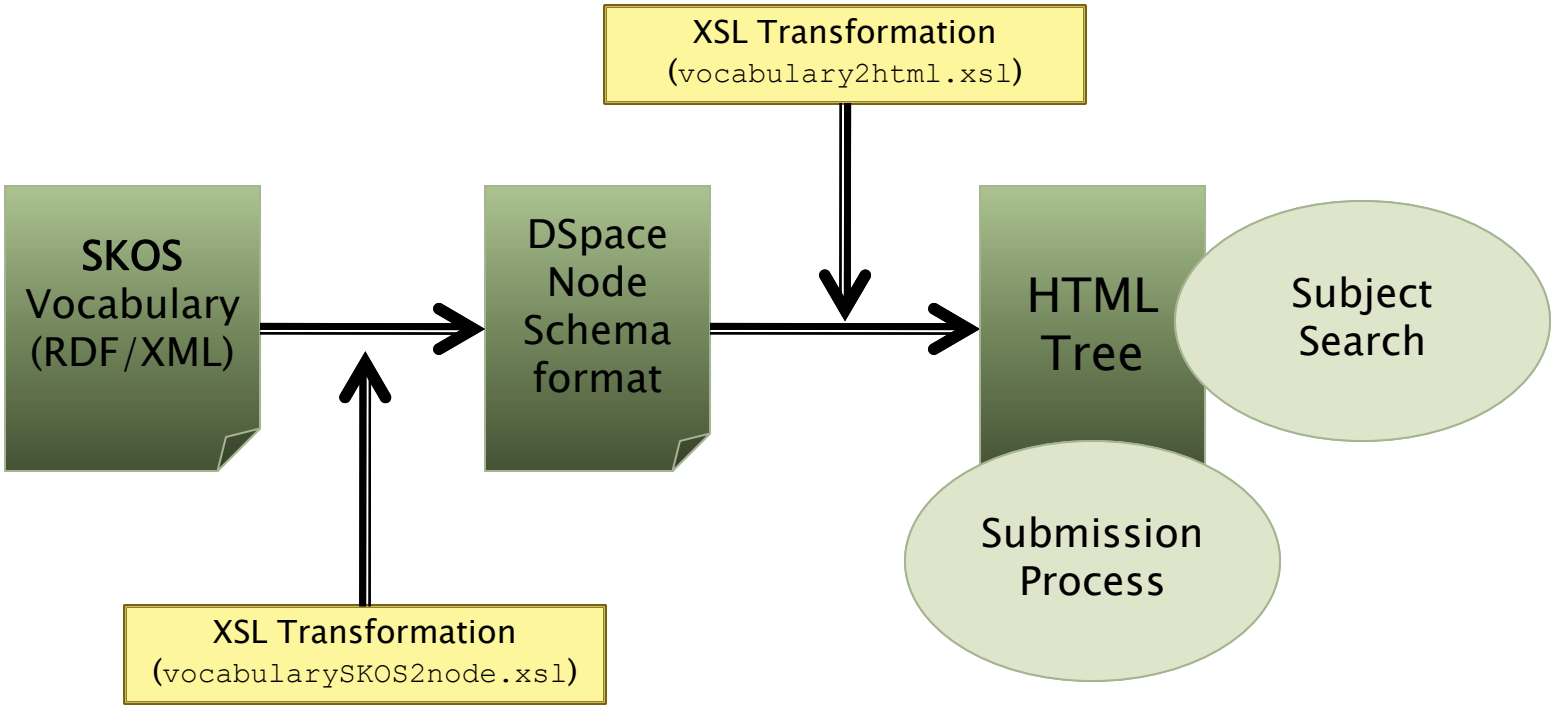
Related Term(s)
“Data retrieval” and “Information processing” *relate to* “Databases”

Controlled Vocabulary add-on for DSpace

What is more:

2. Recognizes thesaurus/controlled vocabularies **expressed in SKOS**
   - RDF/XML format
3. Possibility to assign distinct vocabularies to specific communities
   - Use of the community's particular vocabulary when filling subject fields in the submission process

Vocabulary Ingestion Process *(add-on)*



Application of the Controlled Vocabulary add-on at the University of Patras DSpace Installation

Applied changes

- Updated node schema
  - Parsing and rendering of *Related* and *Use-instead* Terms (`vocabulary2html.xsl`, `ControlledVocabularyTag.java`)
- Support for **SKOS** syntax
  - Adoption of the provided XSL Transformation
  - (`vocabularySKOS2node.xsl`)

Problems

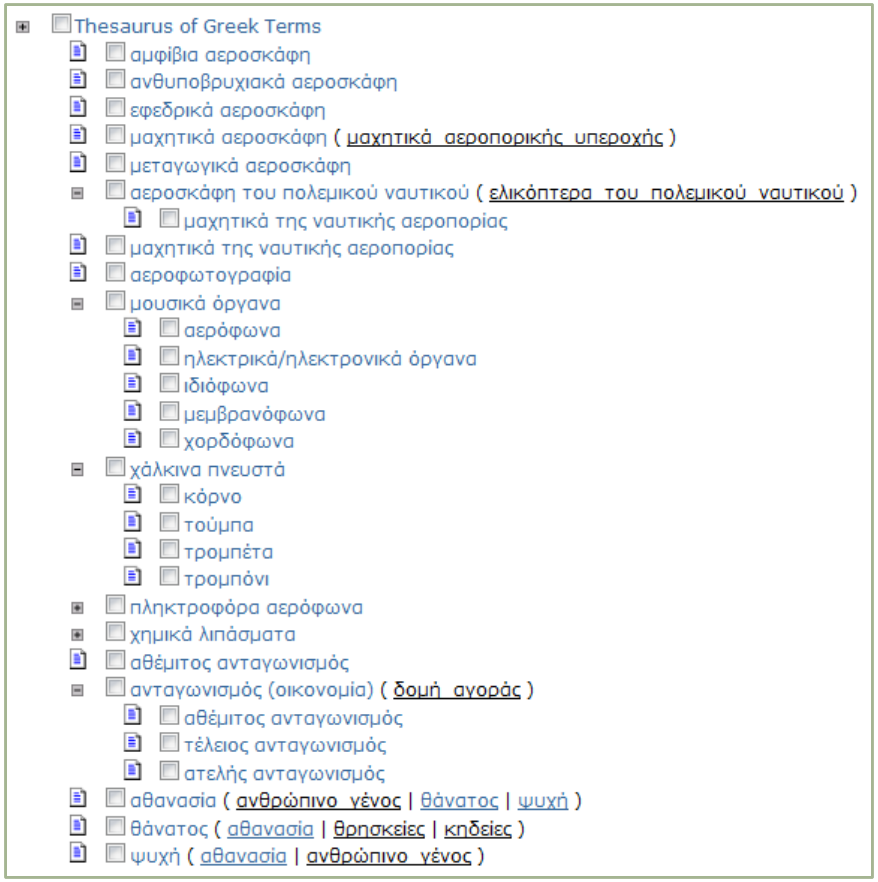
- Only those narrower terms are handled that appear in the thesaurus as separate concepts themselves
  - solved by correcting the skos-to-node XSLT transformation file
- Repetitions/missing terms in the hierarchical form

The EKT Thesaurus in Greece

- Provides a Controlled vocabulary based on
  - the National Library of Greece subject headings
  - subject terms used by the Hellenic Libraries
- Aiming at use/exploitation by all Hellenic Libraries and Information Centres
- Bilingual terms (Greek, English)
- The first such vocabulary aiming at being established as a standard in Greece
  - Incorporation in the Hellenic Public Libraries Union Catalogue

EKT Thesaurus in DSpace

- Part of the SKOSified EKT Thesaurus in DSpace
  - Use of the produced RDF/XML file format
    - requires file extension `.skos`
  - File name augmented by the language code (`_el` for Greek)



EKT Thesaurus in DSpace: Problems

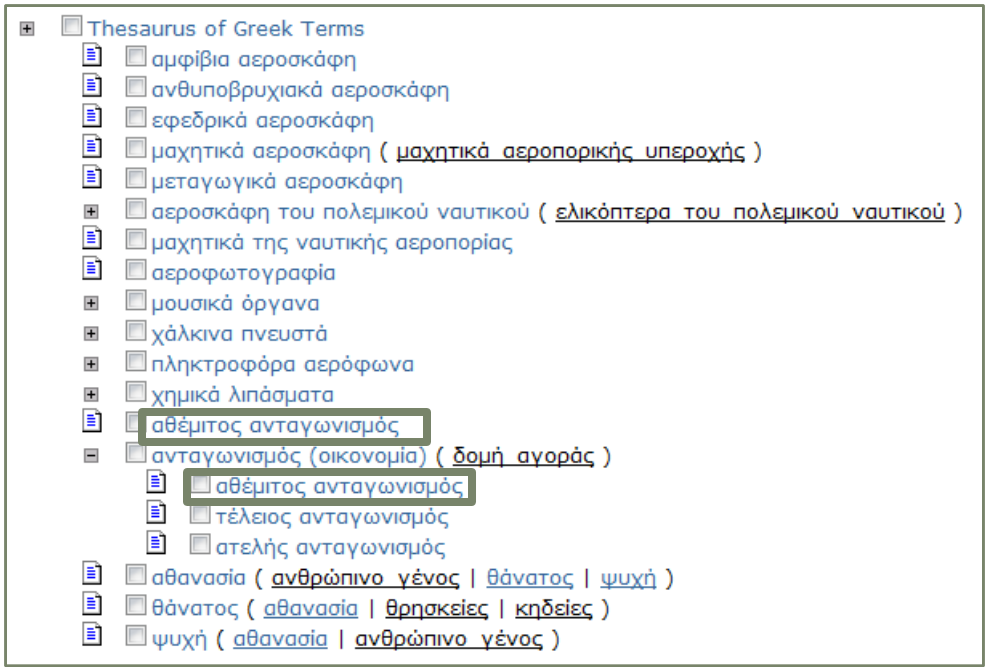
- **Incorrect** rendering in the tree hierarchy
  - Some terms may appear in the wrong level/depth
- **Incomplete** rendering in the tree hierarchy
  - Some terms may be missing
- Why?
  - Provided XLST does not handle every case
  - EKT implementation is not exhaustive
    - Not every possible relation is explicitly asserted
    - (but semantically consistent)

EKT Thesaurus in DSpace – Problems in the Hierarchical Form

1. **Repetition of terms**
   - Some terms appear both **stand-alone** as well as **sub-terms** of other terms in the tree hierarchy

Reason

⇨ Each **<node>** in the node schema will appear at the top level of the hierarchy, regardless of its possible reference as a sub-(or super-) term, by another concept



EKT Thesaurus in DSpace – Problems in the Hierarchical Form

2. **Missing terms**

   - Thesaurus **top concepts** are not present in the node tree

Reason

⇨No separate concept description is provided for these concepts (→*no separate* `<node>` *element exists*)

   - Terms that appear *only as* ***broader*** terms are not included

Reason

⇨No handling of broader terms during parsing

EKT Thesaurus in DSpace – Problems in the Hierarchical Form

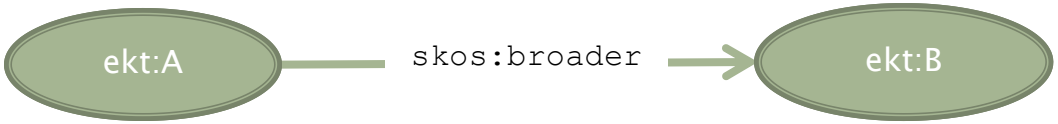
3. **Wrong place of some terms in the node tree**

Reason

⇨ Handling for only narrower (and not broader) terms

Example

asserted relationship:



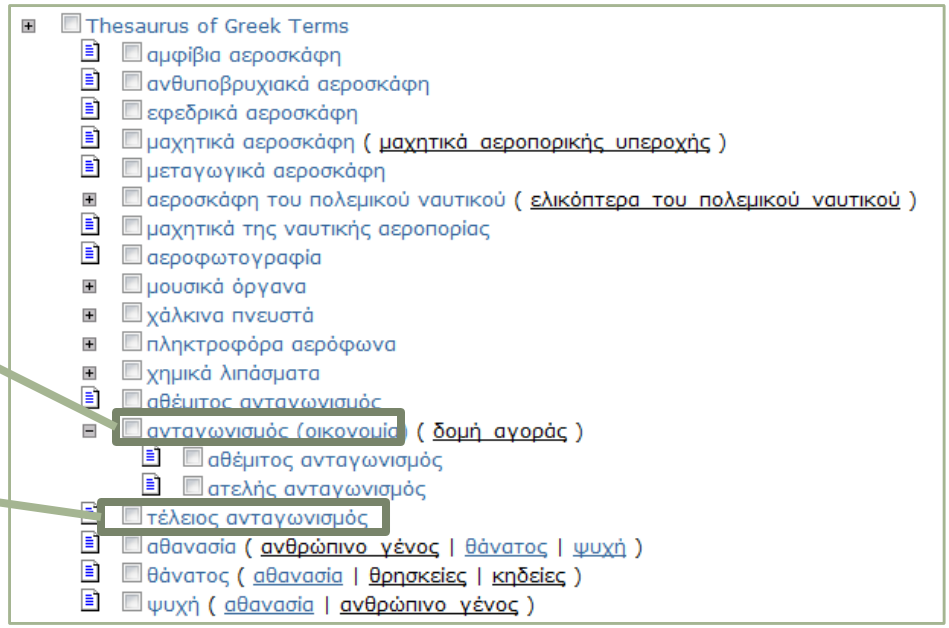
non-asserted relationship:

Term A is rendered as a top term and not under term B!

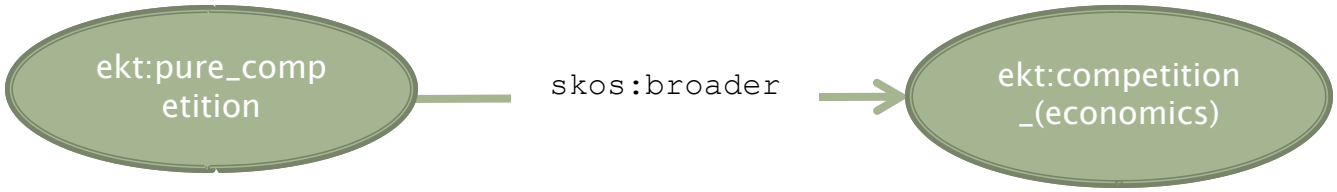
Wrong Place of a Term in the Hierarchical Form

Term:
"ανταγωνισμός (οικονομία)"@el
"competition (economics)"@en

Term:
"τέλειος ανταγωνισμός"@el
"pure competition"@en



asserted relationship:



non-asserted relationship:

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Possible Solution: OWL Ontologies

- SKOS *is* (in) OWL
  - Could exploit semantic relations and axioms
  - Enables reasoning
- The EKT thesaurus as an OWL ontology
  - Programming access to the thesaurus elements
  - Exploitation of the **OWL API** for parsing thesauri ontologies(expressed in RDF/XML format)
  - A simpler way to construct the node tree (instead of complex XSL Transformations)
    - Correct term rendering

    ⇨ No repetitions
- A reasoning based approach
  - Apply an OWL **reasoner** (e.g. FaCT++, Pellet) to the SKOS thesaurus/ontology
    - "Missing" relations could be inferred
    - Inferenced-based classification and rendering of the thesaurus

Inference-based Classification and Rendering: Example 1

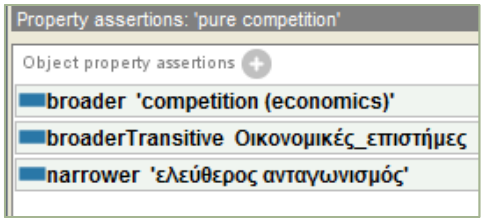
- Construct the top-level hierarchy
  - Possible algorithm

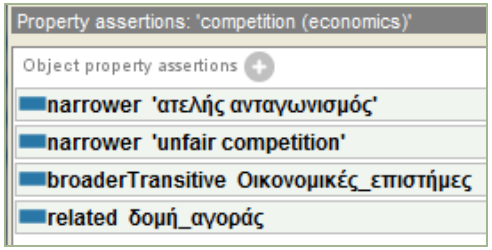
```
find every skos:hasTopConcept term TC;
for-each TC {
   find every skos:narrowerTransitive term NT;
     for-each NT {
        find a skos:broader term BT;
        if no such BT exists then
            add TC skos:narrower NT;
     } //for-each NT
} //for-each TC
```

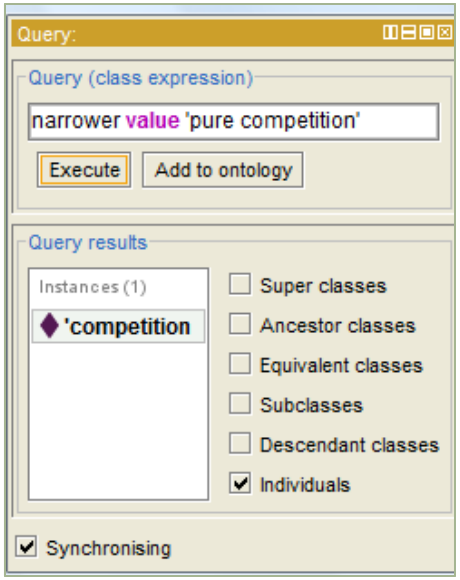
- Result
  - Top concepts appear (correctly)
  - Direct descendants of top concepts appear in their right place

Inference-based Classification and Rendering: Example 2

- Handling of all types of relationships (even of broader)
  - ⇨Terms in their right place (under their broader ones)
  - ⇨No missing terms







Inferenced-based query through Protégé 4: the term 'pure competition' is inferred *to be narrower of 'competition' even though this is not explicitly asserted*