



## A Competency Based Learning Resource Retrieval Process: The LUISA UHP Case-Study

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## Outline



- The research context: LUISA (STREP from FP6)
- Learning resources retrieval
- LUISA in action
- Prototype general architecture
- Focus on knowledge models
  - Common Ontologies
  - Application Specific Ontologies
  - How are the ontologies used?
- Perspectives

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## LUISA project objectives



- To demonstrate feasibility and added value of applications based on an heavy use of semantic based technologies in the learning domain
- To provide a general framework to manage learning resources and to illustrate the improvements brought by the use of semantic web technologies (compared to existing solutions)
- To provide and to test two adaptations of the proposed framework in two different environments
  - An industrial context (EADS/Airbus)
  - An academic context (UHP Nancy1)

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## Digital resources retrieval



Google Advanced Search

Find results with all of the words with the exact phrase with at least one of the words without the words

Language: any language

File Format: Only return results of the file format: Adobe Acrobat PDF (pdf)

Date: Return web pages updated in the: anytime

Numeric Range: Return web pages containing numbers between: and

Occurrences: Return results where my terms occur: in the title of the page

Domain: Only return results from the site or domain: e.g. google.com, org, .fr

Usage Rights: Return results that are: free to use or share, even commercially

MERLOT Multimedia Educational Resource for Learning and Online Teaching

Material Advanced Search

Find material by keyword: Keywords: any words all words exact phrase

Find material by attributes:

Title: [ ]

URL: [ ]

Description: [ ]

Comments: Any

Subject Category: Selected: All

Language: Any

Material Type: Any

Technical Format: Any

Audience: Any

Learning Management System: Any

cost involved copyright

section 508 compliant source code available

- Lots of resources potentially available
- Standards to ensure interoperability
- However most retrieving processes are still keyword based
- Solutions based on semantic web technologies not yet widely experimented
- Questions for LUISA
  - Is it feasible?
  - Which cost?
  - What can be shared and reused?

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## Case study (academic context)



- Focus on providing on line resources for on campus students
  - To improve personalisation of provided resources
- To allow academic staff to retrieve and select resources for their students
  - Allows to search and retrieve small size resources(e.g. exercise) To recombine them in wider sets available on students portal.
  - → *on line resources and new resources production (limited recombination)*

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## Academic context (2)



### Explored scenarios

- *Basic competencies in Informatics and Internet*      *C2i, mandatory in French higher education for being awarded a bachelor degree*

- *To acquire or to improve one of the C2i competencies*      *A student will be able to prepare the C2i exam*

- *The teachers*      *Will find more easily resources adapted to their students' needs*

- *Students alone*      *Will have the opportunity to train themselves according to their needs (on campus or distance students)*

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## Annotation Interface



Start over

**Title:**

**Title:** Informatique II : GIMP (The GNU Image Manipulation Program) \*

**Language:** French

**Title:** Computer II : GIMP (The GNU Image Manipulation Program) \*

**Language:** English

**Description:**

**Description:** · Familiarize you with a software image editing  
· Use the basic functions (brush selection, Gum ...);

**Language:** English

**Description:** · Vous familiariser avec un logiciel de retouche d'images  
· utiliser les fonctions de base (pinceau, ...)

**Language:** French

**Identifier:**

**Catalog:** <http://luisa.uhp-nancy.fr/>

**Entry:** 197

**Language:** French

Start over

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## Luisa in action - Interrogation step : Preferences



**Personal preferences**

OS:   
windows98  
windowsMillenium  
windowsXP  
windowsVista  
**\_windows**  
macOSX  
\_macOS  
ubuntu606

Software: (multiple selection)  
\_application  
\_compressTool  
\_antivirus  
\_fileApplication  
\_burningApplication  
\_officeApplication  
\_pdfReader  
powerPoint2003  
openImpress2

CurrentsportSciences  
discipline:  Uhp Field Of Study

- Scientific Field Of Study
  - Life Sciences
    - biology
    - biogeography
  - Mathematics Computer Science
    - mathematics
    - computerScience
  - Health
  - Physics And Chemistry Sciences
  - sportSciences**
- Non Scientific Field Of Study

Max duration:

**University preferences**

Cost:

Language:

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## Luisa in action - Interrogation step : the query



Luisa

Query phase

C2I Competencies

Legenda

- 0 competency not acquired
- 1 competency not yet acquired, level is not enough
- 2 competency acquired, level is enough
- 3 competency acquired, level is very good

C2I Competencies

- A1 Be aware of ICT's evolution
- A2 Comprehend ethical issues
  - A2-1 Basic international laws (A2-1)
  - A2-2 Online identity (A2-2)
  - A2-4 Confidentiality (A2-4)
  - A2-5 Critical mind on sources (A2-5)
  - A2-6 Politeness (A2-6)
- B1 Control one's environment of work
  - B2 Search for information
  - B3 Save, secure and back-up one's data in a local place or on a network
  - B4 Realize documents for printing
  - B5 Realize offline and online presentations
  - B6 Communicate remotely
  - B7 Realize a collaborative project

Preferences Reset Profile Search

Luisa moodle site You are logged in as GRANDBASTIEN Monique (Logout)

Luisa LUISA extension Query phase

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## UHP Scenarios in action



Luisa

Query phase

C2I Competencies

Legenda

- 0 competency not acquired
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- 3 competency acquired, level is very good

C2I Competencies

- A1 Be aware of ICT's evolution
- A2 Comprehend ethical issues
  - B1 Control one's environment of work
  - B2 Search for information
    - B2-1 Distinguish search engine (B2-1)
    - B2-2 Design requests (B2-2)
    - B2-3 Use search results (B2-3)
  - B3 Save, secure and back-up one's data in a local place or on a network
  - B4 Realize documents for printing
  - B5 Realize offline and online presentations
  - B6 Communicate remotely
  - B7 Realize a collaborative project

Preferences Reset Profile Search

Luisa moodle site You are logged in as Admin User (Logout)

Luisa LUISA extension Query phase

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The user checks the competencies for which he wishes to search Los  
The GUI takes into account the "requires" relationship to hide-unhide competencies

The user query is sent to the Negotiation Layer

For the query the GUI provides the user with:  
A tree representation of the c2i competencies  
For each competency, the current user level

## Luisa in action : Retrieved resources



[Luisa](#) [moodle site](#) You are logged in as **GRANDBASTIEN Monique** (Logout)

[LUIISA](#) ▶ [LUIISA extension](#) ▶ [Query phase](#) ▶ [Selection phase](#)

Selection phase

Your query:	Your selection:
<b>C21</b> Competencies: Critical mind on sources (A2-5) Online identity (A2-2) Politeness (A2-6) Confidentiality (A2-4) Basic international laws (A2-1) 4 LO(s) found in workplan 0 LO(s) found in alternativeplan	<ol style="list-style-type: none"> <li> <a href="#">Droit et deontologie de l'Internet (1) Infractions commises par des personnes physiques</a> (3 stars) ↑  <small>(http://www.uhp-nancy.fr/ontologies/LUIISA#aa72f1e9c8116c4d3e542)</small>                      Competencies: b4                 </li> <li> <a href="#">Internet et le droit (2)</a> (3 stars) ↑  <small>(http://www.uhp-nancy.fr/ontologies/LUIISA#aa1881da151168c681133)</small>                      Competencies: k_confidentiality; k_basic_international_laws; k_critical_mind_on_sources                 </li> <li> <a href="#">Droit et deontologie de l'Internet (1) Infractions commises par des personnes physiques</a> (3 stars) ↑  <small>(http://www.uhp-nancy.fr/ontologies/LUIISA#aa1881da151168c5bfc7c)</small>                      Competencies: k_politeness; k_basic_international_laws; k_virus                 </li> <li> <a href="#">vr - gerer son identite en ligne</a> (2 stars) ↑  <small>(http://www.uhp-nancy.fr/ontologies/LUIISA#d687c2c5-21a3-11dd-8739-a303fa7fc89)</small>                      Competencies: k_online_identity                 </li> </ol>

[Work with these resourc](#)

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## Ressources composition (optional)



[Luisa](#) [moodle site](#) You are logged in as **Admin User** (Logout)

[LUIISA](#) ▶ [LUIISA extension](#) ▶ [Query phase](#) ▶ [Rules](#)

Rules

Your selection:	Rules
<b>Learning objects:</b> <ul style="list-style-type: none"> <li> <a href="#">Moteurs de recherche et annuaires</a> (4 stars) ↑  <small>(http://www.uhp-nancy.fr/ontologies/LUIISA#aa1881da151168c3e2c0d)</small> </li> <li> <a href="#">Systemes de gestion de fichiers (2)</a> (4 stars) ↑  <small>(http://www.uhp-nancy.fr/ontologies/LUIISA#aa1881da151168c06f43d)</small> </li> <li> <a href="#">systemes d'exploitation (2) Architecture de l'ordinateur</a> (4 stars) ↑  <small>(http://www.uhp-nancy.fr/ontologies/LUIISA#aa1881da151168bf1a14f)</small> </li> </ul>	Number Of Resources: min: <input type="text"/> max: <input type="text"/> Number Of Resources Lectures: <input type="text"/> Number Of Resources Exercises: <input type="text"/> Number Of Resources Exams: <input type="text"/> Learning style: classic <input type="radio"/> discovery <input type="radio"/> Consistency In Repository: yes <input type="radio"/> no <input type="radio"/> Consistency In Language: yes <input type="radio"/> no <input type="radio"/> <input type="button" value="Apply"/>

[Moodle Docs for this page](#)

[LUIISA](#) ▶ [LUIISA extension](#) ▶ [Query phase](#) ▶ [Rules](#)

You are logged in as **Admin User** (Logout)  
[Home](#)

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## Proposed packages



### Composed packages

Package 0	Les sorties La transmission de donnees et d'informations Storage	<input type="button" value="Save"/>
Package 1	La transmission de donnees et d'informations Storage Traitements	<input type="button" value="Save"/>
Package 2	Storage Traitements Internet (1) Introduction to networks *	<input type="button" value="Save"/>
Package 3	Traitements Internet (1) Introduction to networks * Systemes de gestion de fichiers (2) *	<input type="button" value="Save"/>
Package 4	Internet (1) Introduction to networks * Systemes de gestion de fichiers (2) * Operating Systems (2) The Computer Architect *	<input type="button" value="Save"/>
Package 5	Systemes de gestion de fichiers (2) * Operating Systems (2) The Computer Architect * Systemes d'exploitation (1) *	<input type="button" value="Save"/>
Package 6	Operating Systems (2) The Computer Architect * Systemes d'exploitation (1) * BUSINESS OBJECT REPORTER ET EXPLORER	<input type="button" value="Save"/>
Package 7	Systemes d'exploitation (1) * BUSINESS OBJECT REPORTER ET EXPLORER PHOTOSHOP INITIATION	<input type="button" value="Save"/>
Package 8	BUSINESS OBJECT REPORTER ET EXPLORER PHOTOSHOP INITIATION EXCEL 97 INTERMEDIAIRE	<input type="button" value="Save"/>

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## Luisa in action :working phase



**moodle site**

You are logged in as **GRANDBASTIEN Monique (Logout)**

**LUIISA** ▶ **LUIISA extension** ▶ **Query phase** ▶ **Working phase**

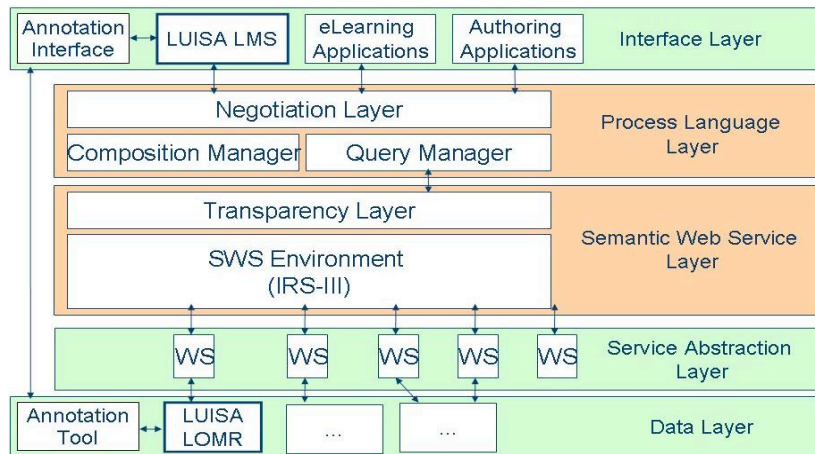
Working phase

**Working phase**

- << **Internet et le droit (2) \*** >> (<http://www.uhp-nancy.fr/ontologies/LUIISA#aa1881da151168c681133>)  
Competencies: k\_confidentiality; k\_basic\_international\_laws; k\_critical\_mind\_on\_sources
- << **Droit et deontologie de l'Internet (1) Infractions commises par des personnes physiques \*** >> (<http://www.uhp-nancy.fr/ontologies/LUIISA#aa1881da151168c5bfc7c>)  
Competencies: k\_politeness; k\_basic\_international\_laws; k\_virus

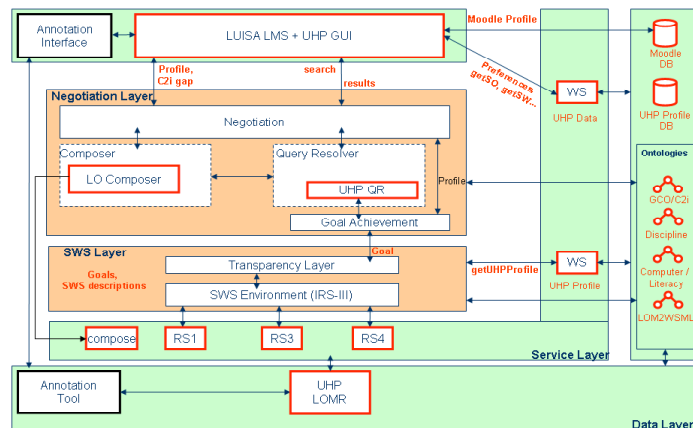
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## LUISA global architecture



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## Academic case adaptation



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## Focus on embedded knowledge

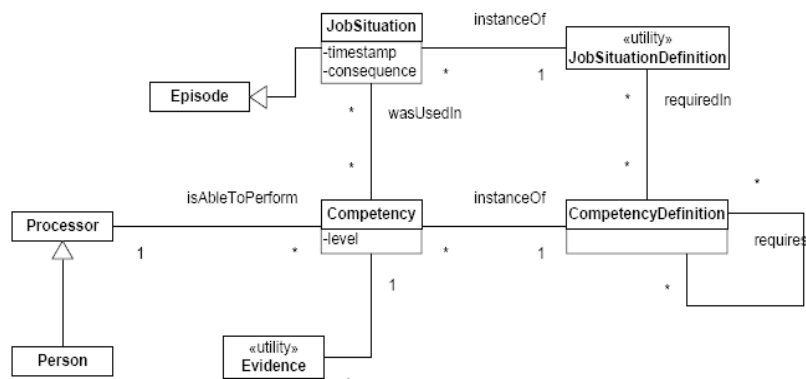


A knowledge layer which encompasses

- Common knowledge
  - An ontology for describing learning resources
    - Based on LOM
  - An ontology for describing competencies: gcs
    - Based on GCO (HR-XML)
- Knowledge specific to a given environment
  - Common ontologies specialisations
  - Specific ontologies
    - uhp-disciplines, uhp-computer\_literacy

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## A general competency ontology



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## A resource ontology (LOM)

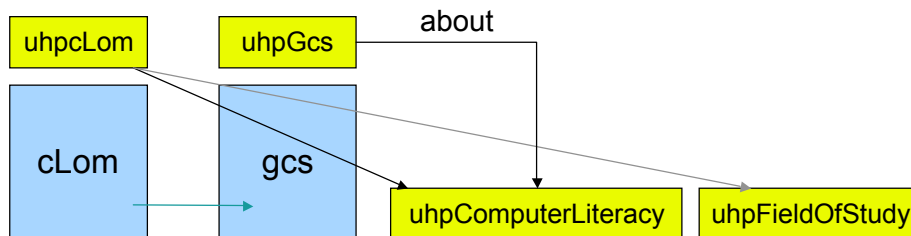


The screenshot shows the WSMO Studio interface. On the left, the 'Navigator' displays a tree structure of classes under the URL 'http://www.cc.uah.es/ontologies/LUISA/LOM2WSML'. The tree includes classes like 'Annotation', 'Classification', 'DateTime', 'Duration', 'HumanLanguage', 'LangString', 'LangString-Single', 'LearningObject', 'LOMIdentifier', 'MetadataSchema', 'MIMEType', 'oc\_AdministrativeUnit', 'oc\_GeographicalRegion', 'oc\_Microtheory', 'oc\_Thing', 'oc\_TimeInterval', 'Relation', 'TaxonId', 'TechnicalRequirement', 'vCard', and 'VocabularyItem'. The 'LearningObject' class is selected and highlighted in blue.

The main area shows the 'Ontology Editor' for 'http://www.cc.uah.es/ontologies/LUISA/LOM2WSML'. The 'Header' section shows the 'Identifier' as 'http://www.cc.uah.es/ontologies/LUISA/#LearningObject'. The 'Attributes' section lists various properties with their cardinalities, such as 'Identifier [0..1]', 'Title [0..1]', 'Language [0..\*]', 'Description [0..\*]', 'Keyword [0..\*]', 'Coverage [0..\*]', 'Coverage-SpatialLocation [0..\*]', 'Coverage-TemporalPeriod [0..\*]', 'Coverage-Jurisdiction [0..\*]', 'Structure [1..1]', 'AggregationLevel [1..1]', 'Version [1..1]', 'Status [1..1]', 'Contribute-Entity [1..\*]', 'Contribute-Date [1..1]', 'Contribute-Role [1..1]', 'MetadataRecord-Identifier [0..1]', 'MetadataContribution-Role [1..1]', 'MetadataContribution-Entity [1..\*]', 'MetadataContribution-Date [1..1]', 'MetadataSchema [0..\*]', 'MetadataLanguage [0..\*]', 'Format [0..\*]', 'Format-MIME [0..\*]', 'Size [1..1]', and 'Location [0..\*]'. The 'Super Concepts' and 'Instances' sections are currently empty.

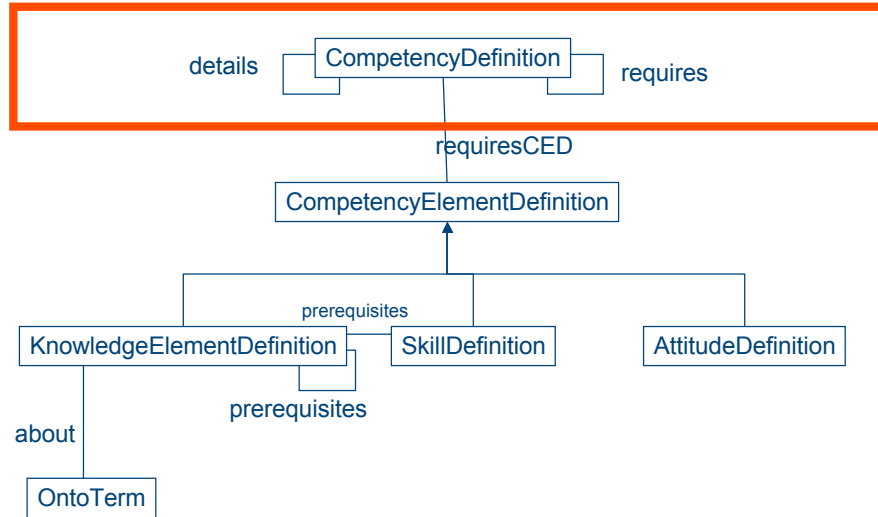
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## From common ontologies to specific ones



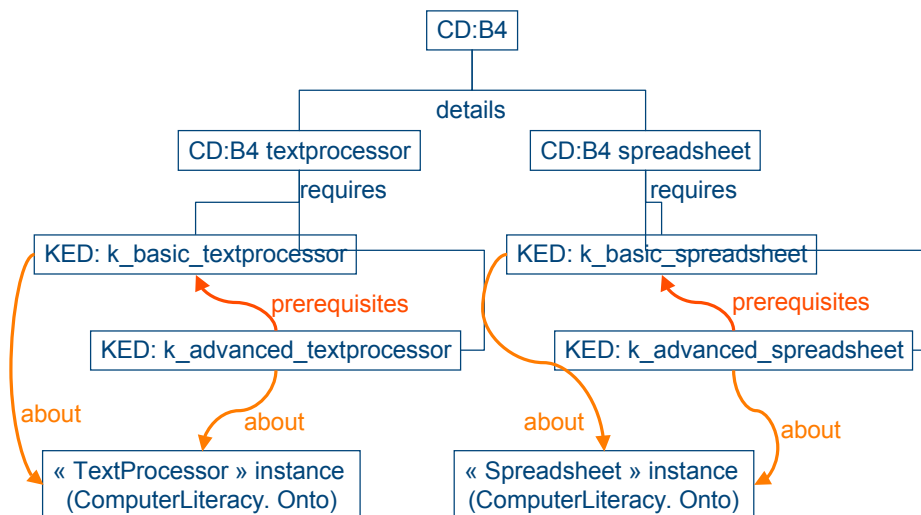
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## GCS/C2I : competency definition



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## GCS/C2I : instance level



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## The disciplines ontology



Table 1 : Sub-concepts of FieldOfStudy

Mathematics-Computer Science	Field of study composed of Mathematics and Computer Science.	
Mathematics		
Computer Science		
Physics_and_chemistry Sciences	Field of study composed of Physics, BioPhysics and Chemical Engineering.	
Physics	LinkedTo	Mathematics
BioPhysics		
Chemical Engineering		
Health	Field of study composed of Medicine, Pharmacology, dentistry and ergonomics.	
Medicine	LinkedTo	Biology
Pharmacology	LinkedTo	Biology
Dentistry		
Ergonomics		
Life Sciences	Field of study composed of biology and biogeography.	
Biology		
Biogeography		
Sport sciences		

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## Annotation tool



Start over

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**Language:** French

**Title:** Computer II : GIMP (The GNU Image Manipulation Program) \*

**Language:** English

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· utiliser les fonctions de base (pinceau, ...)

**Language:** French

**Identifier:**

**Catalog:** <http://luisa.uhp-nancy.fr/>

**Entry:** 197

**Language:** French

Start over

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9		
9.1	Purpose	
	Required competency	<b>1</b> B2: Search of information <b>2</b> B5.3: Realize hypertexts documents integrating texts, sounds, static and dynamic images and links. <b>3</b> B6.1: Use email
	Targeted competency	The same as the required competencies because this is an exam. <b>4</b> B2: Search of information <b>5</b> B5.3: Realize hypertexts documents integrating texts, sounds, static and dynamic images and links. <b>6</b> B6.1: Use email
	Topic	<ul style="list-style-type: none"> <li>▪ Search engine</li> <li>▪ H T M L editor</li> <li>▪ Email application</li> </ul>
	Discipline	No discipline because the data dealt by the resource is generic enough.

Table 1: LO sample for academic use case

- Three processes in LUISA:
  - **Annotation** of resources with the annotation tool
  - **Retrieval** in the repositories and results display
  - **Work** with selected resources

## Resource selection



- Three steps
  - Step 1
    - Using competency criteria
  - Step 2
    - Using preferences
  - Step 3
    - Using pedagogical criteria

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## Query Resolver : step 1



- For each target competency
  - Search based on competency annotation
    - Add competency elements to the competency list
    - Retrieve the resources which match the query
  - Search based on « topics » annotation
    - Build the topic list based on the « bout » relation in the competency ontology
    - Retrieve the resources which match the query
  - Step result = R-listof candidate resources

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## QR step 2 : constraints verification



- For each element in the R-list do
  - If one of the constraint from preferences is not satisfied, delete the resource from the R-list
  - If one of the constraints coming from pre-requisites relation (GCO-C2i ontology) is not satisfied, delete the resource from the R-list
  - Step result = P-list of resources to be proposed

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## QR step 3:final selection criteria



- From here the selection is based on pedagogical and personalisation criteria. Those criteria may be combined from several viewpoints, leading to different results for the learner.
- In the implemented scenario the following criteria were used:
  - Package composition: for each target competency, include at least one presentation and one exercise
  - **Resources coherence** : prefer resources from the same author or edited by the same institution or targeted to the same category of students
  - **Discipline coherence** (if applicable): if theresource uses data, prefer data from the discipline of the student
  - Peer evaluation: prefer a resource with a high peer rating

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### QR step 3 (2):criteria application



- Criteria previously listed are assigned different weights which all together give a global weight.
- Display organisation: for each targeted resource
  - Select the best weighted presentation
  - Select the best weighted exercise
  - Put them in the « proposed » basket
  - Put the others in the alternative basket
- Step result= a set of resources

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### Experimentations



- The prototype was « used » with
  - C2i teachers
  - librarians
  - students
- Main feedbacks
  - Wide interest for the competency tree and its dynamic features
  - Interest for the topic based search which allows to use all the « legacy » metadata (no competency indexes usually)
  - Request for more explanations about the retrieval process

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## Conclusions (1)



- About adapting the general framework
  - Success in two very different settings
  - Ontologies
    - GCO-ontology and LOM ontology easily specialised
    - Building domain specific ontologies
      - Difficulties to find ontologies to reuse (moreover 3 years ago)
      - Difficulties for keeping them updated
        - » Need for the creation of new instances by the end-user through an « ad-hoc » interface

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## Conclusions (2)



- About observed benefits
  - Annotation tool flexibility (annotation profiles)
  - Enriched annotations for a cost which is similar to LOM annotation
  - Dynamic display of competencies allows the user to reflect about where he/she is in terms of competency mastering
  - Final selection personalisation
  - Perspectives for adding rules explaining the selection process
- From the technical viewpoint
  - Answers to requests are still too long (> 1 mn)
  - But the completely distributed environment does work
  - A more detailed performance analysis is necessary to check where the times bottlenecks are

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- Merci! Thank you! Obrigado!
- Questions?