Semantic Search of Learning Services in a Grid-Based Collaborative System


GSIC / EMIC Group
University of Valladolid, Spain

http://gsic.tel.uva.es
Cardiff, May 7, 2005
Index

- Introduction
- Service discovery mechanisms
- An ontology for semantic search of learning tools
- Ontology-enabled registry of learning services
- Conclusions
Context

Domain

Techniques

Implementations

Prototype

CSCL

- scripting
- service oriented computing
- grid

+ grid services

IMS-LD

Gridcole
The problem

How to discover appropriate learning services?
- What information about learning services is available?
- How can educators perform the search?
Requisites for service discovery

- **Educator-centric**
  - Using educational abstractions
  - Enough expressiveness for their queries

- **Focus on CSCL tools**
  - Description of their capabilities
    - Type of tools, collaboration properties, educational tasks supported

- **Accuracy**
Methodology

- Analysis of current approaches for service discovery
  - Service registries: UDDI, Index Service
  - Ontology-based: OWL-S
- Definition of an ontology for the description of learning services
- Ontology-enabled registry of services
  - Integration in a CSCL system
Index

- Introduction
- Service discovery mechanisms
- An ontology for semantic search of learning tools
- Ontology-enabled registry of learning services
- Conclusions
Service discovery mechanisms

- **UDDI: registry of Web Services**
  - Standard for publishing and discovering services
  - Information about organizations and offered services
  - Allows **only** querying for
    - Service name, location, business, bindings
  - Problems
    - Service capabilities not described
    - Keyword based matching

- **In grid infrastructures**
  - UDDI is commonly used
  - Index Service in GT3: soft-state registration, but same problems as UDDI
Ontologies for service discovery

- **Semantic description of services**
  - Shared by a community
  - Enhanced accuracy in the search by unambiguous semantics
  - Expressive, high-level abstractions

- **Understandable by humans and machines**
  - Can be used for service discovery
Semantic Web Services: OWL-S

- OWL-S: ontology to semantically annotate Web Services
  - Automated *discovery*, invocation, composition
- Service functionality defined
  - Inputs, outputs, preconditions, effects
- But…
  - Must be extended to describe learning services
  - Technological view, *suitable for educators?*
## Comparison

<table>
<thead>
<tr>
<th></th>
<th>Educator centric</th>
<th>CSCL tool properties</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UDDI, Index Service</strong></td>
<td>Depending on provided keywords</td>
<td>Not defined</td>
<td>Keyword matching: low</td>
</tr>
<tr>
<td><strong>OWL-S</strong></td>
<td>Need extension for learning services, technological view</td>
<td>Limited: inputs, outputs, preconditions, effects</td>
<td>Semantic based: high</td>
</tr>
<tr>
<td><strong>Ontology of learning tools</strong></td>
<td>Educational abstractions, high-level view</td>
<td>User types, tasks, groups, interactions, learning artifacts</td>
<td>Semantic based: high</td>
</tr>
</tbody>
</table>
Index

- Introduction
- Service discovery mechanisms
- An ontology for semantic search of learning tools
- Ontology-enabled registry of learning services
- Conclusions
Some competency questions

- Which tool characteristics should be considered?
- Is a tool individual or collaborative?
- What tasks can a tool perform?
- What tools can be used to support an asynchronous debate?
- What tools can visualize PDF documents?
- What user types are defined and what can they do?
Overview of the conceptual model of the ontology

Diagram depicting the relationships between various concepts such as CollaborativeInteraction, IndividualInteraction, ComputerMediatedInteraction, Input, Output, LearningTool, Group, Person, TipoOfUser, Role, Activity, Task, Group, Person, Content, LearningObjective, and Scenario.
Excerpt of the hierarchy of learning tools

Learning Tool

- Individual Tool
  - Document Based Tool
    - Document Viewer
    - Browser
  - Communication Tool
    - Document Editor
    - Text Editor
  - Asynchronous Tool
    - Synchronous Text Editor
- Collaborative Tool
  - Asynchronous Tool
  - Synchronous Tool
    - EMail
    - Chat

Task orientation

Interaction orientation
Description of a synchronous editor

<table>
<thead>
<tr>
<th>TOOL NAME</th>
<th>MOST SPECIFIC TOOL TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>synchEditor</td>
<td>SynchronousEditor</td>
</tr>
</tbody>
</table>

**TOOL DESCRIPTION**

A word text editor that allows the synchronous edition of Word documents by groups of at most 5 individuals.

**USER TYPES**

- **editor**
  - Allowed tasks: docviewing, edition
- **viewer**
  - Allowed tasks: docviewing

**TASKS**

<table>
<thead>
<tr>
<th>docviewing</th>
<th>edition</th>
</tr>
</thead>
<tbody>
<tr>
<td>• input: doc files</td>
<td>• input: doc files</td>
</tr>
<tr>
<td>• computer mediated interaction</td>
<td>• output: doc files</td>
</tr>
<tr>
<td>• individual</td>
<td>• computer mediated interaction</td>
</tr>
<tr>
<td>• collaborative</td>
<td>• individual</td>
</tr>
<tr>
<td>• synchronous</td>
<td>• collaborative</td>
</tr>
<tr>
<td>• group size: ≤ 5</td>
<td>• synchronous</td>
</tr>
<tr>
<td></td>
<td>• group size: ≤ 5</td>
</tr>
</tbody>
</table>

**TECHNICAL DETAILS**

Implementation technology: Grid Service

Provider: GSIC
Index

- Introduction
- Service discovery mechanisms
- An ontology for semantic search of learning tools
- **Ontology-enabled registry of learning services**
- Conclusions
System outline
Querying the system

Teacher

I want a tool for edition of .doc documents in groups of 4 persons

Ontology-based service search system

- Found service: synthEditor

A tool for edition task is an editor

- .doc is a format of text document: the tool is a text editor of .doc documents

Group size of 4 persons: collaborative tool that supports groups of group size ≥ 4 members

- And with UDDI/Index Service?
  - Possible with keywords?
- And with OWL-S?
  - Difficult…

Semantic description of services
Some problems with this approach

- Knowledge engineering
  - Difficult, cannot be automated

- Domain-dependent tools
  - E.g. simulator of TCP/IP networks

- Enough details?
  - E.g. awareness: group windows, telepointers, WhatYouSeeIsWhatISee

- Increased system complexity
  - Ontology editors, metadata repositories, reasoners, appropriate interfaces for educators
Index

- Introduction
- Service discovery mechanisms
- An ontology for semantic search of learning tools
- Ontology-enabled registry of learning services
- Conclusions
Conclusions

- Discovery of learning services is challenging
  - Benefits of semantic-based approaches

- An ontology of learning tools for CSCL systems is proposed
  - Shared knowledge, iterative process
  - Educational focus, CSCL-relevant characteristics
  - Knowledge reusable, e.g. a learning design authoring tool

- Preliminary prototype of an ontology-based registry for Gridcole
Semantic Search of Learning Services in a Grid-Based Collaborative System


GSIC / EMIC Group
University of Valladolid, Spain

http://gsic.tel.uva.es

Cardiff, May 7, 2005