UNIVERSIDADE FEDERAL DE SANTA CATARINA

Construindo Aplicações na Web Semântica
Aplicações em EaD

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Exemplos de aplicações

1. **UnA-SUS**
   - Catalogação e busca de objetos de aprendizagem para a área de saúde
   - Generalização para outros domínios de aplicação
2. **Semantic Learning Objects**
   - Expansão de consultas com uso de ontologias
   - Negociação entre agentes com apoio de (mapeamentos entre) ontologias
3. **DLNotes**
   - Anotação semântica em bibliotecas digitais
   - Estudo de caso com a Biblioteca Digital de Literatura Brasileira

UnA-SUS – Universidade Aberta do SUS

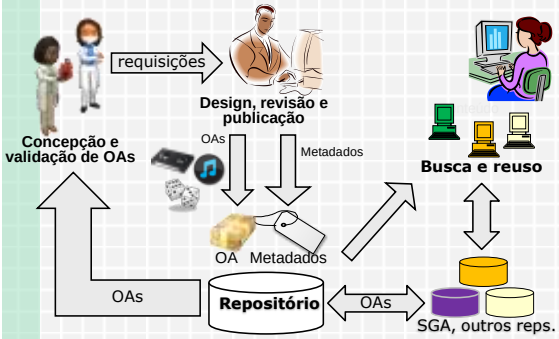
- Programa do Ministério da Saúde para atender necessidades de **formação** e **educação** permanente dos **trabalhadores do SUS**
- Ações focadas em ***e-learning***:
  - formulação de conteúdo
  - bibliotecas digitais
  - cursos a distância

Metas da UnA-SUS

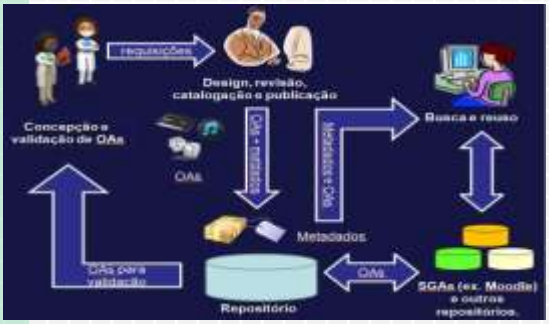
- Desenvolver um **Ambiente Virtual de Ensino e Aprendizagem**
  - plataforma **Web** para **gestão** de **Objetos de Aprendizagem (OAs)**

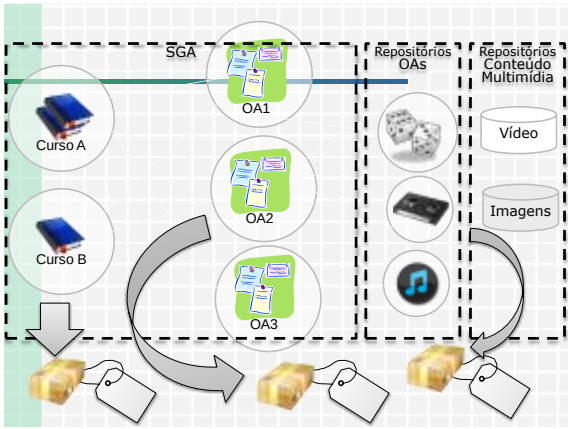
  - composição **modular** e **multimídia** de **OAs**
- Montar e oferecer cursos para formação continuada de profissionais da saúde
  - **Especialização em Saúde da Família (ESF)**

O processo de produção, catalogação e reuso de OAs



O processo de produção, catalogação e reuso de OAs

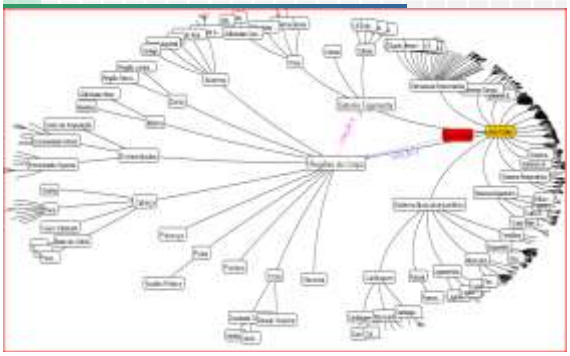




Reuso é essencial

- OAs são caros para produzir !!!
- Demandas emergenciais na saúde pública exigem agilidade e pronta resposta com cursos, para a qualificação de profissionais

Navegação hiperbólica no DeCS



Catalogação de Objetos de Aprendizagem (OAs) usando Vocabulários Controlados

- Seleção de termos do DeCS, CID-10, SNOMED, ...
  - via fornecimento de palavras-chave que são pesquisadas na base de conhecimento
  - via navegação em uma visão do conhecimento em forma de árvore

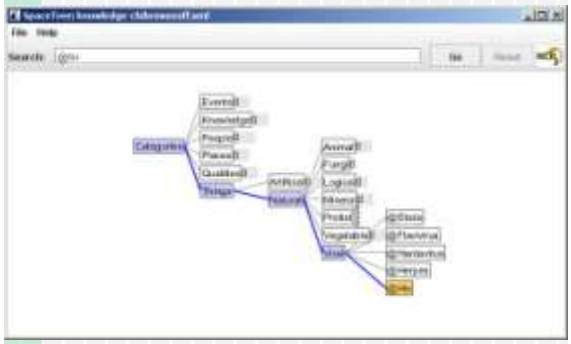
Seleção via contexto ontológico

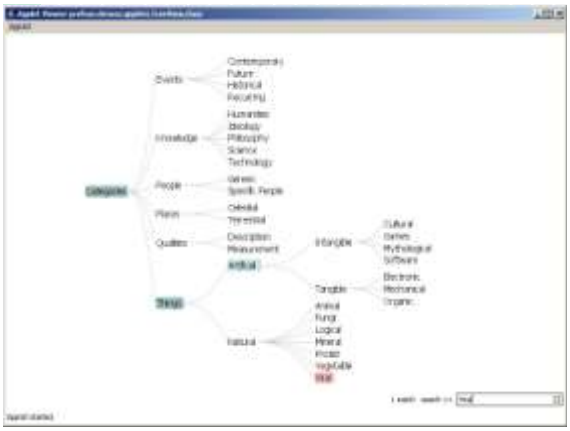
Protótipo (catalogação com entrada de palavra-chave)

DSpace:Catalogação de OA.swf

Protótipo (catalogação com navegação na base de conhecimento)

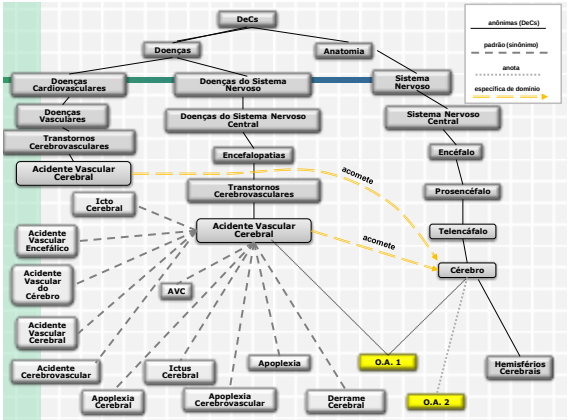
DSpace:Recuperação de OA.swf

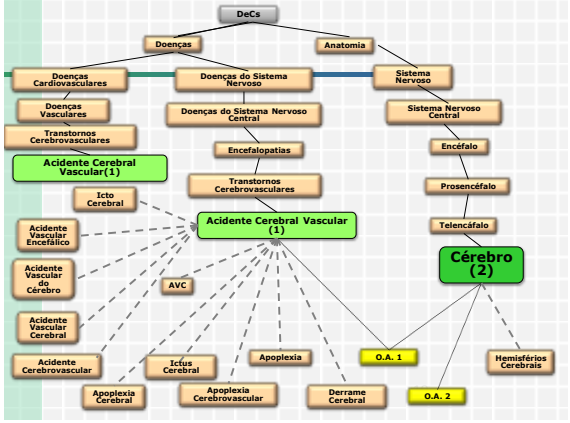




Recuperação de Objetos de Aprendizagem (OAs) Baseada em Conhecimento

- Vocabulários e relações semânticas:
  - Oriundos do DeCS
  - Definidos pelos catalogadores de OAs
  - Gerados pelo cruzamento de informações com o CID-10 (Classificação Internacional de Doenças)
  - Ex: sinônimos, é um(a), parte de, causa, efeito, sintoma, etc.





Busca de OAs na área de saúde usando conhecimento de domínio

- [x] ANATOMIA
  - [ ] Regiões do Corpo
    - [x] Abdome
      - [ ] Cavidade Abdominal
        - [x] Peritônio
          - [ ] Saco de Douglas
          - [ ] Mesentério +
          - [ ] Omento
          - [x] Cavidade Peritoneal
          - [ ] Estomas Peritoneais
        - [ ] Espaço Retroperitoneal

Semantic Learning Objects

(VIAN, J. ; SILVEIRA, R. A. ; FILETO, R . , WCCE 2009)

Problem 1: Heterogeneous metadata standards for LOs

LOM	Dublin Core	IMS LRM	ISO MLR	AICC Metadata
Title	Title	Title	Title	Title
Description	Description	Description	Description	Description
Keyword	Subject	Keyword	Subject	Keyword
Contribute, role	Contributor, Creator, Publisher	Contribute, Role	Contributor, Role	Contribute, Role
Format	Format	Format	Format	Format

Proposal

- Communication between the search interface (Web application) and the Searcher agent via xmlrpc protocol.
- Agents message exchange based on FIPA ACL (Foundation for Intelligent Physical Agents - Agent Communication Language) agents language.
- Agents communication with ontology using the Jena Framework

Proposal

The Multi-agent system proposed have two type of agents: Indexer and Searcher.

Agent Diagram – O-MASE methodology draw with eclipse's plugin AgentTool III

Proposal

Indexer (one instance per repository):

• It indexes LOs in the repository, using the vector model for information recovery (i.e., counting word occurrences in the metadata values) extended with weights for different metadata elements

• It receives messages from searcher agents looking for LOs described with specific terms in specific metadata elements

• It is able to map LO metadata standards and retrieve LOs from the repository regardless of the metadata standards used for their description

Proposal

Example of LO description

- LOM (Scorm 1.2 object made with *EXelearning* tool; file *imslrm.xml*)

```
.....
<?xml version="1.0"?>
<lom
 xmlns="http://www.imsglobal.org/xsd/imsmd_rootv1p2p1"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="http://www.imsglobal.org/xsd/imsmd_rootv1p2p1
   imsmd_rootv1p2p1.xsd">
 <general>
      <title>
                <langstring>Stroke and tabagism</langstring>
      </title>
.....
```

Proposal

Example of LO description

- Dublin Core (IMS object made with the *EXelearning* tool; file dublincore.xml)

```
<metadata
   xmlns="http://www.exelearning.org/metadata/dc/"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://www.exelearning.org/metadata/dc/
   http://www.exelearning.org/metadata/dc/schema.xsd"
 xmlns:dc="http://purl.org/dc/elements/1.1/"
 xmlns:dcterms="http://purl.org/cd/terms/">

<dc:title>Stroke and tabagism</dc:title>
.....
```

Proposal

Indexing – Vector model extended with weights for metadata elements

$$N = n_1 * f_1 + n_2 * f_2 + \ldots + n_x * f_x)$$

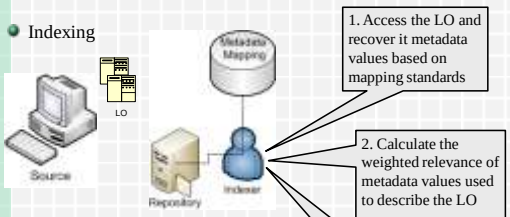
N = weighted frequency of the term in the LO description
n_i = number of occurrences of the term in the metadata element i
f_i = relevance factor for the metadata element i

$$P = N * log\ (NO/\ NOC)$$

N = Weighted frequency of the term in LO
NO = Total number of LOs in the repository
NOC = Number of LOs in the repository that contain the term
P = Relevance of the term in the LO description

Proposal

- Indexing




```
Term {
     LO - A (Weight_A)
     LO - B (Weight_B)
}
```

Proposal

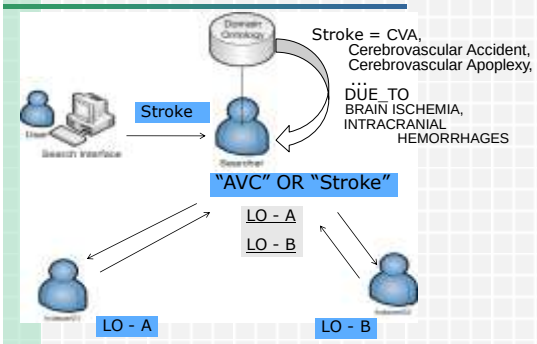
Searcher (one instance per User):

• It receives requests from the user, preprocess them using a domain ontology (to solve ambiguities and extend queries with related concepts and instances), and communicates with indexing agents to look for LOs to answer the request

• It waits for responses from indexers, informing the existence of LOs related to the search, ranks the resulting list of objects and presents it to the user

• Present options for refinement and expansion of the search if necessary and options for downloading and presenting the LOs.

Semantic searching



Case study: health sciences

- Developing *e-learning* facilities for UnaSUS (Open University of the Brazilian Health System)
- Techniques based on metadata and ontologies to provide semantic means for:
  - Cataloguing LOs from several heterogeneous data sources and repositories (LOR)
  - Searching for LOs with better levels of precision and recall
  - Defining contents for courses that target specific audiences and needs (e.g., professionals like doctors and nurses, specific themes like swine flu treatment)
  - Support the reuse of LOs in the composition of different courses

Health Science Descriptors (DeCS)

Medical Subject Headings (MeSH)

- MeSH Heading: Stroke
- Entry Term: Apoplexy
- Entry Term: Cerebral Stroke
- Entry Term: Cerebrovascular Accident
- Entry Term: Cerebrovascular Accident, Acute
- Entry Term: Cerebrovascular Apoplexy
- Entry Term: Cerebrovascular Stroke
- Entry Term: CVA (Cerebrovascular Accident)
- Entry Term: Stroke, Acute
- Entry Term: Vascular Accident, Brain
- Scope Note: A group of pathological conditions characterized by sudden, non-convulsive loss of neurological function due to BRAIN ISCHEMIA or INTRACRANIAL HEMORRHAGES. Stroke is classified by the type of tissue NECROSIS, such as the anatomic location, vasculature involved, etiology, age of the affected individual, and hemorrhagic vs. non-hemorrhagic nature. (From Adams et al., Principles of Neurology, 6th ed, pp777-810)

MeSH structure 1

MeSH structure 2

Conclusions

- Our proposal provide interoperability between repositories of LOs described with a variety of metadata standards and vocabularies.
- It includes facilities for semantic searching LO repositories, with a potential to improve search results and foster the reuse of LOs
- An ongoing work, with lots tasks to do yet:
  - Finish implementation
  - Make empirical tests to evaluate the benefits in real applications
  - Take into account the specific user preferences to generate customized search results
  - Use ontologies also in the indexers in order to enrich the possibilities of negotiation between indexer and search agents

Supporting Collaborative Learning Activities with a Digital Library and Annotations

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Table of Contents

Introduction

- Digital Libraries (DLs)
  - Information systems for supporting the organization and easy access to collections of digital contents (documents, image, video, etc.)
  - Contents are described by metadata
    - **Dublin Core (DC)**: *Title, Creator, Date, Subject, Publisher, Format, Description, Contributor, Identifier, Type, Rights, Language, Source, Relation,* and *Coverage*

Introduction

- Digital libraries and learning
  - DLs are sources of documents for learning
    - Scientific papers, literature, etc.
  - They can provide easy access to documents independent of time (always available) and space (on the Web)
  - Just providing access to documents is not enough. New functionalities are also required:
    - Allow the individual and collective construction of knowledge (sharing information)
    - Support communication among DL's users (students and instructors)
  - Adopted solution: **Annotation system on DL's**

Annotations and learning

- One annotation has two parts:
  - The **anchor**
    - Identifies the annotated portion of the document
    - One passage of a text, one region of an image or graphic, or a position in a video, ...
  - **Attached information**
    - Additional information: comment, criticism, questions, examples, review aid, …
    - Organize information: identify concepts, instances, their properties and relations

Annotations and learning

- Annotation types
  - Free-text annotations
    - Associate an anchor to additional information (text which is freely defined by the annotator)
    - Comparable to the activity of reading and freely writing notes on the paper

Title: Free-text annotation example
Author: Renato Fileto
Contents:
These slides were originally produced by Roberto Willrich in French for a presentation in Tolouse

Annotations and learning

Annotation Types

- Semantic annotations (based on ontologies)
  - Associate an anchor to one or more semantic descriptions (e.g., "Roberto Willrich " instance of professor)

Author
Surname: Willrich
FirstName: Roberto
Institution: UFSC

Knowledge Base

- Semantic descriptions can be stored in an ontology or in a knowledge base

Annotations and learning

Annotation Types

- Semantic annotations (based on ontologies)
  - Associate an anchor to one or more semantic descriptions (e.g., "Roberto Willrich " instance of professor)

- **Ontology**
  - Formal and explicit conceptualization of an universe of discourse
  - Concepts, relations, instances, and axioms
  - RDF, OWL: W3C's standards to represent and exchange knowledge and ontologies

Annotations and learning

Annotation Types

- Semantic annotations (based on ontologies)
  - Associate an anchor to one or more semantic descriptions (e.g., "Roberto Willrich " instance of professor)

- **Knowledge Base**
  - Collection of knowledge
  - For our work, it is an ontology populated with **individuals (instances de concepts)**

Knowledge Base

The *DLNotes* System

- *DLNotes* : Annotation System for DLs
  - Supports the creation and management of annotations on the DL's contents
    - free-text annotations
    - semantic annotations (referring to an ontology)
      - The majority of the annotation systems support just either free-text annotations or semantic annotations, though both types of annotations are useful for learning
  - Enables knowledge construction and sharing for learning activities (enriching the DL)
    - private annotation set and knowledge base for each user
    - public annotations and knowledge base shared by all users

The DLNotes System

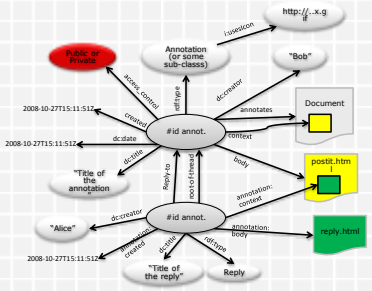
- *DLNotes* : Annotation System for DLs
  - Fosters the communication among users
    - Via discussion threads that can be associated to each annotation
  - Supports the specification and execution of « annotation activities »
    - Activities consisting of the creation of annotations
    - The students must analyze the DL's contents (e.g., a document) and create a set of specific annotations
    - Examples:
      - Identify and classify the characters (personages) from a book
      - Identify the figures of speech in a passage

The *DLNotes* System

- *DLNotes* : Annotation System for DLs
  - Can be easily integrated with DLs, via its API
  - Adaptable to the domain of the DL
    - By changing the ontology used for semantic annotation
  - The users can cooperatively feed the public knowledge base with
    - individuals (instances of the concepts described in the ontology) identified in the contents
    - semantic annotations referring to these instances or concepts
  - Case study : *DLNotes* integration with the Digital Library of Brazilian Literature (DL-BL)

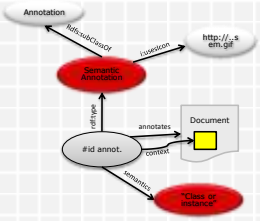
The *DLNotes* System

- DLNotes annotation schema
  - Extends W3C's Annotea annotation schema (based on RDF)



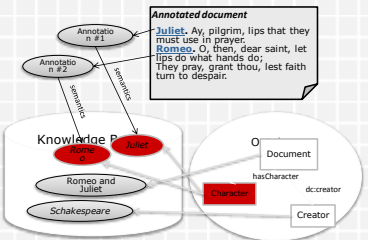
The *DLNotes* System

- DLNotes annotation schema
  - Extends W3C's Annotea annotation schema (based on RDF)
    - A new annotation type ("Semantic Annotation") and its property "semantics" which points to a class or instance

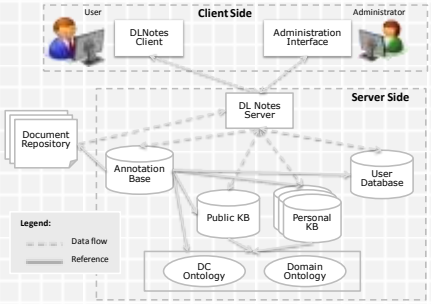


The *DLNotes* System

- *DLNotes* semantic annotations
  - Allow the user to associate a portion of the text (anchor) to concepts or instances
  - When a new term is identified by the user, he can generate an instance in the knowledge base by creating an annotation



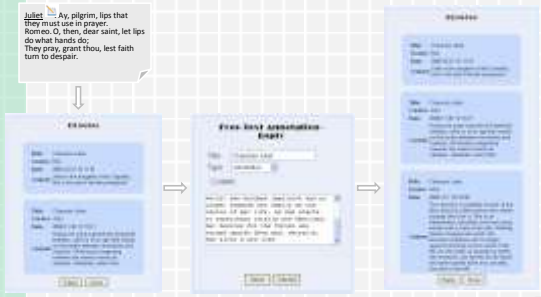
DLNotes Architecture



The *DLNotes* user interface

The *DLNotes* user interface

Discussion thread about an particular annotation



The *DLNotes* Prototype

- Implementation
  - LAMP (Linux, Apache, MySQL et PHP)
  - AJAX (Asynchronous JavaScript et XML)
  - RAP API (RDF API for PHP)
- Integration with a DL
  - Requires code changing in the DL to call *DLNotes* API
  - All links (URL-doc) which can be annotated must be changed with a call to the *DLNotes* annotation method
    - *startAnnotationSession(user, annotActiv, URL-doc)*

Case study

- The Digital Library of Brazilian Literature (DL-BL)
  - Only literary works in public domain
    - 63112 works
    - 676 digitized (HTML) and reviewed
  - Information about the Brazilian writers
    - 15930 writers
  - Literary reviews

Case study

- *DLNotes* integrated with the Digital Library of Brazilian Literature (DL-BL)
  - The goal is to demonstrate the use of *DLNotes* and make tests
  - We are developing an ontology about literature teaching
    - The first portion defines classes of personages, their relationships, and geographic links.
      - Based on the Ethnographic Thesaurus of the American Folklore Society

Case study

Case study

Case study

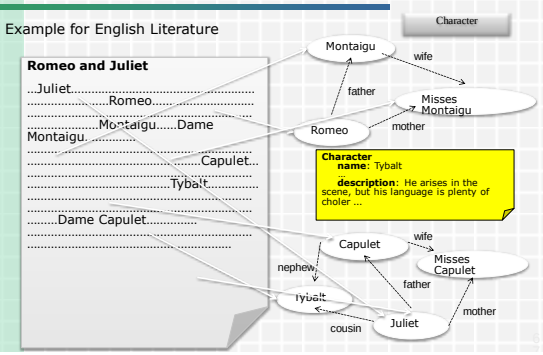
- Literary Analysis
  - Interpretation of a literary work
  - Made in several stages
    - Each stage corresponds to an annotation activity

Case study

- Literary Analysis
  - **Stage 1 « *Personages Identification* »**
    - The student must identify the personages for creating semantic annotations by instantiating individual of the *Character* class or one of its sub-classes (Actor, Antagonist, Villain, Caricature,...)
    - The notes can be associated to the personages with free text annotation (e.g. comments)

Case study

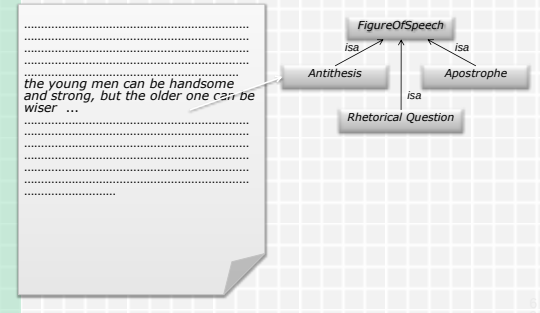
Example for English Literature



Case study

- Literary Analysis
  - **Stage 2 « *Figures of Speech* »**
    - The student can identify the figures of speech used in the contents and associate the respective passages in the text with the correspondent subclasses of *FigureOfSpeech* in the ontology (e.g., *antithesis*, *apostrophe*, *rhetorical question*).

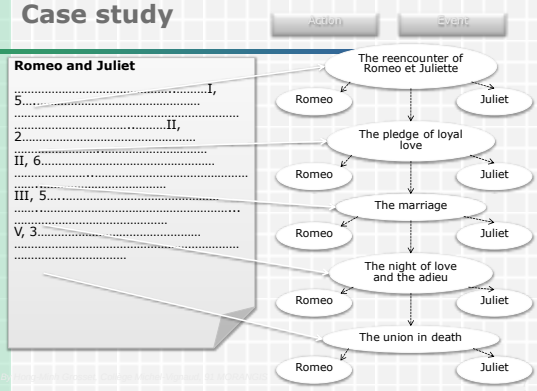
Case study



Case study

- Literary analysis
  - **Stage 3 « *The Plot* »**
    - Describe the sequence of events and actions
      - Make semantic annotations to identify instances of the classes *Event* and *Action* in the contents
      - Instances of *Event* and *Action* can be related to
        - instances of Character (e.g., in order to indicate who does an action)
        - Other instances of *Event* and *Action* (e.g., in order to indicate causality or conflicts)

Case study



Conclusions

- *DLNotes*
  - An annotation system for DLs intended to support learning
    - Supports free-text and semantic annotations, public and private, on the contents of a DL
    - Provides means for educators and their students to share knowledge and foster their communication
    - Not coupled to the DL
      - But can be easily integrated with a variety of DLs

Conclusions

- Future work
  - Finish the implementation of all functionalities
  - Integration with *Moodle*
  - Use the knowledge base for
    - Semantic search based on the acquired knowledge,
    - One module for creating inference rules on the knowledge base,
    - Treating incompatibilities and inconsistencies in the knowledge base (specially the public one)

Referências: Web Semântica e EaD

- *Demetrios G. Sampson, Miltiadis D. Lytras, Gerd Wagner and Paloma Diaz (editors)*. **Special Issue on Ontologies and the Semantic Web for E-learning.** *Journal of Educational Technology & Society*, 7(4), 2004.
- Anderson, T. and Whitelock, D. **The Educational Semantic Web: Visioning and Practicing the Future of Education**: *Journal of Interactive Media in Education*, 2004 (1), Special Issue on the Educational Semantic Web. ISSN:1365-893X [www-jime.open.ac.uk/2004/1]
- Devedzic, V. **Education and the Semantic Web**. *International Journal of Artificial Intelligence in Education*, 14 (2004) 39-65.
- Ohler, J. **The Semantic Web in Education**. *EDUCAUSE Quarterly,* 31(4), 2008.

Alguns projetos na UFSC

- http://www.lisa.ufsc.br/projetos
- http://www.unasus.ufsc.br
- http://www.literaturabrasileira.ufsc.br

Perguntas?