Ontology Based Application Server to Execute Semantic Rich Requests

Flávia Linhalis and Dilvan de Abreu Moreira

University of São Paulo - Brazil

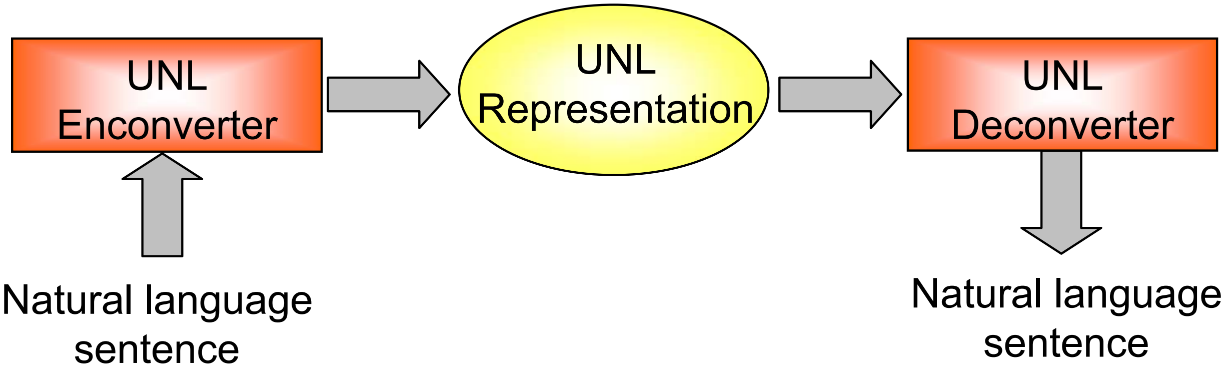
Introduction

- Application Servers
  - Provide functionalities of conventional middleware + technologies for Web access
  - Facilitate the development of component based applications by providing transparency to programmers

- Ontology Based Application Servers (OBAS)
  - Ontologies to integrate the services of an application server, like J2EE (Oberle et al., 2004)
  - OBAS technology has the potential to be the future of today’s application servers for the Semantic Web

Introduction

- Web to help breaking the language barrier
  - The Universal Networking Language (UNL) project has this goal
  - Started in 1996, it embraces research institutions from several countries
  - A DeConverter and EnConverter for each language form a Language Server residing in the Internet to allow users to communicate in their native language



Introduction

- Our work joins that two ideas:

  1) to use UNL to make natural language computer readable

  2) to use an OBAS to semantically enrich the execution of services.

- An Ontology Based Application Server function is to execute Natural Language requests (NL-OBAS).

Introduction

- NL-OBAS allows users to write requests for servers, using their native language.

- To achieve this goal, the NL-OBAS performs a semantic mapping between UNL relations and software components using ontologies. It:
    - transparently hides the dynamic composition of a service to execute the request
    - searches for suitable software components to compose that service

The UNL Project

- UNL represents sentences using three elements:
  - Universal Words (UWs): Each UW relates to a concept represented as an English word.
  - UWs can be optionally supplied with semantic information to restrict its meaning.
  - Examples:
    - book
    - book (icl>publication)
    - book (icl>reserve)

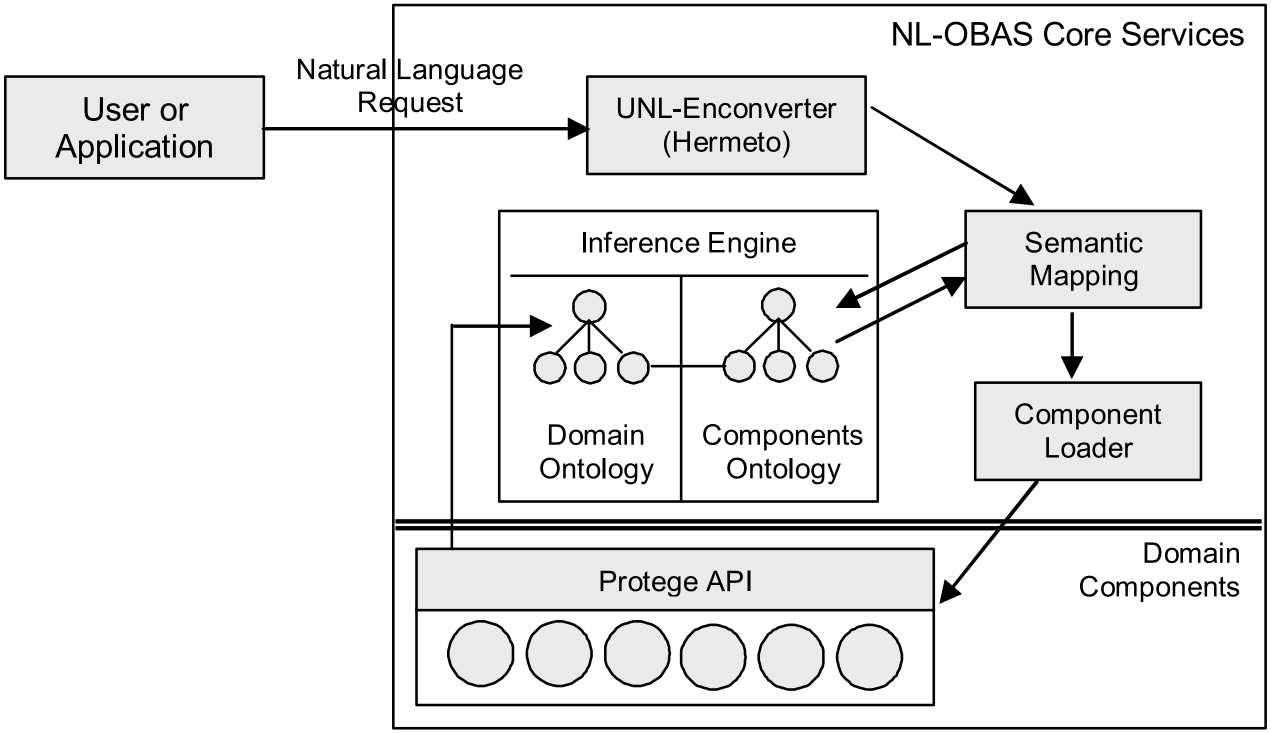
The UNL Project

- Relation Labels (RLs): express semantic relations between UWs.
  - RLs are represented as a pair relation_label(UW1, UW2).
  - There are today 45 RLs defined.
  - Example:
    - obj (move, table): defines a thing that is affected by an event. The example means the “table moved”.

- Atribute Labels (ALs): express additional information about UWs (verb tense, intention, emphasis, etc).
  - Example: obj(eat.@past, apple.@pl).

NL-OBAS General View

- UNL-Enconverter (Hermeto): converts NL into UNL.
- Semantic Mapping: uses the Component Ontology and the UNL relations to extract semantic information to search the suitable components.



- Component Loader: loads components and executes specific methods to fulfill the natural language request.
- The application domain is described in the Domain Ontology.

NL-OBAS Description

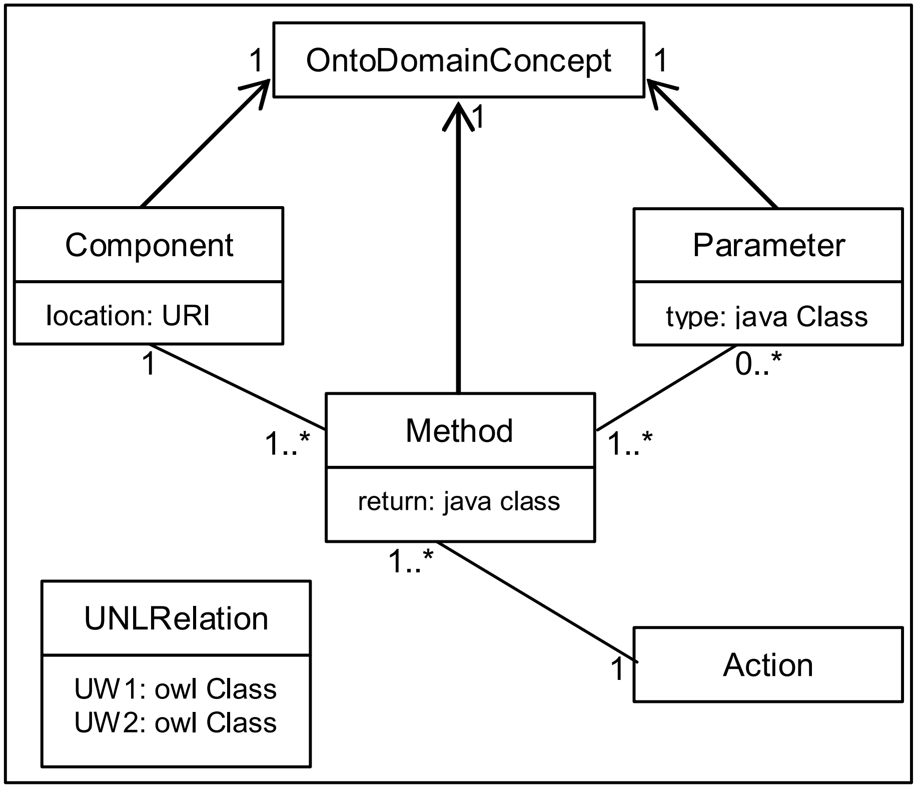
- The UNL-Enconverter Service (Hermeto)

  - Hermeto system is the core of UNL-Enconverter Service.
  - It can be used to convert any natural language into UNL.
  - It receives as input a dictionary and a grammar for each language.

  - English grammar and dictionary were developed to the course management domain (only to imperative sentences).

NL-OBAS Description

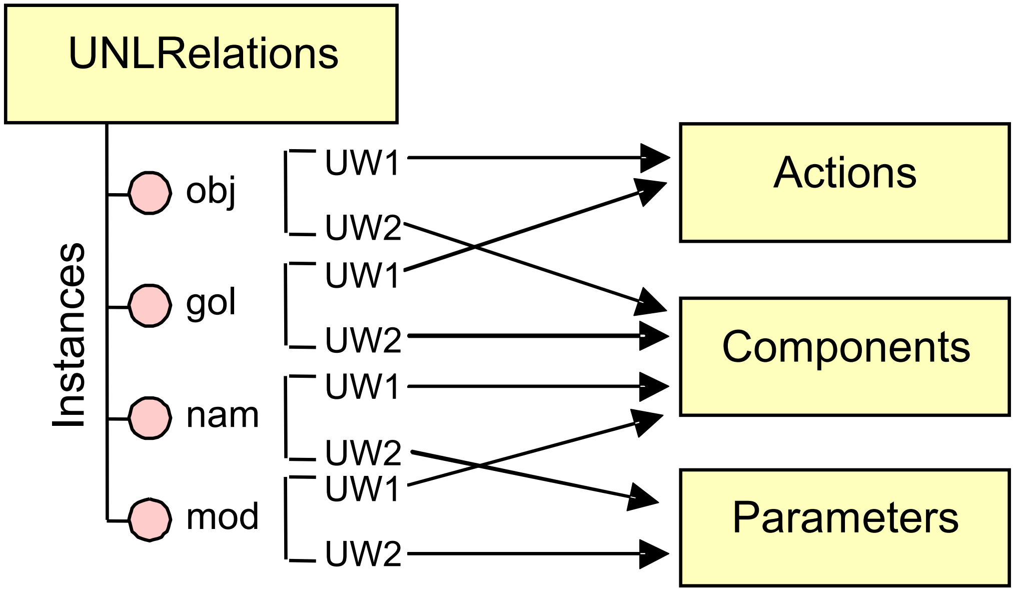
- Component Ontology
  - It describes the domain software components



- OntoDomainConcept → concepts related to the domain. Each instance is a class of the Domain Ontology.
- Component → represents the components. Each component representation is related to one concept in the Domain Ontology.
- Method → methods of components.
- Parameter → methods arguments.
- Action → imperative verbs. Each method is related to one action.

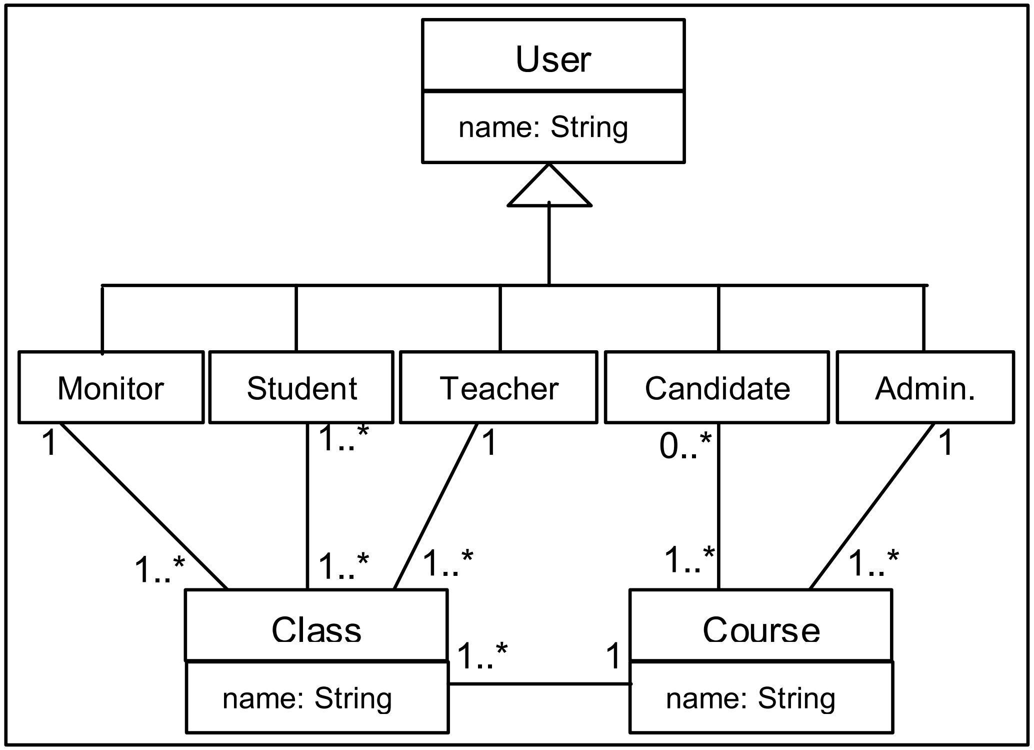
NL-OBAS Description

- Component Ontology (UNLRelations class)
  - Its instances are UNL relations
  - The UWs of each relation are related with classes Component, Parameter or Action of the Component Ontology



NL-OBAS Description

- Domain Ontology
  - It was created and instantiated to the course management domain



NL-OBAS Description

- Component Loader
  - It uses Java Reflection to load the components and execute its methods

- Domain Components Layer
  - The components can perform queries and modify the instances of the Domain Ontology
  - They can perform external actions, such as send e-mails
  - Each component is related to a concept of the Domain Ontology

NL-OBAS Description

- Semantic Mapping Service (SMS)
  - It performs a semantic mapping between UNL relations and software components (using the Component Ontology)
  - It identifies the component, methods and arguments to execute the request
  - Example: "*Delete administrator Mary from course Java*".
    - The UNL-Enconverter Service generates the following UNL representation:

```
obj(delete,administrator)
gol(delete,course)
nam(administrator,Mary)
nam(course,Java)
```

NL-OBAS Description

- Example:
  - The SMS uses the Component Ontology and the semantics of the UNL representation to identify the following information:

Action: delete
Main Concept: administrator
Other Concept: course
Argument: Mary
Argument type: administrator
Argument: Java
Argument type: course
Number of arguments: 2
Return type: none

  - This information is used to search for the suitable component and, finally, the Component Loader is called.

Related Works

- Sugumaram and Storey (2003) use ontologies to search for components
  - Natural language to specify the components description
  - Their work do not execute requests

- OAA (Open Agent Architecture) and SOTA
  - They also use components or agents to execute natural language requests.
  - Our differential and advantage:
    - Requests are converted to an interlingua → communication in several languages.

Conclusion and Future Work

- NL-OBAS can be used in different application domains. It is necessary to:
  - build the appropriate software component set,
  - define the dictionary and the grammar rules,
  - create instances of the Component Ontology,
  - define the Domain Ontology.
- Future Works:
  - Improve the dynamic service composition: it is limited by the number of imperative verbs.
  - Perform the semantic mapping to other kind of sentences (not only imperatives)
  - Extend NL-OBAS to support enterprise applications (using, for example, Jboss)

Acknowledgments

Thanks to Interinstitutional Center for Computational Linguistics (NILC - São Carlos/Brazil) for making the UNL-HERMETO system available to our research.

And the Protégé Team.

Contacts

- Flávia Linhalis:

  flavia@icmc.usp.br

- Dilvan de Abreu Moreira:

  dilvan@stanford.edu

  dilvan@gmail.com