Task 4.9 (3.11)

Natural Language and Speech Interfaces to Knowledge Repositories

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Outline

- **Objectives**
- **Task Activity Overview**
- **Results**
- **Proposal for JPA3**

Natural Language and Speech Interfaces to Knowledge Repositories

- Principles, methodologies and software for the automation of the construction of natural language and speech interfaces to knowledge repositories

- Disambiguation of natural language user queries using Domain Ontologies and User Profiles, result ranking

- Explore the interplay of speech processing with natural language processing in a particular domain.

- Develop an application demonstrator of natural language and speech interfaces to knowledge repositories

- Heuristic Evaluation of the prototype - Evaluation Study involving representatives of the target user group
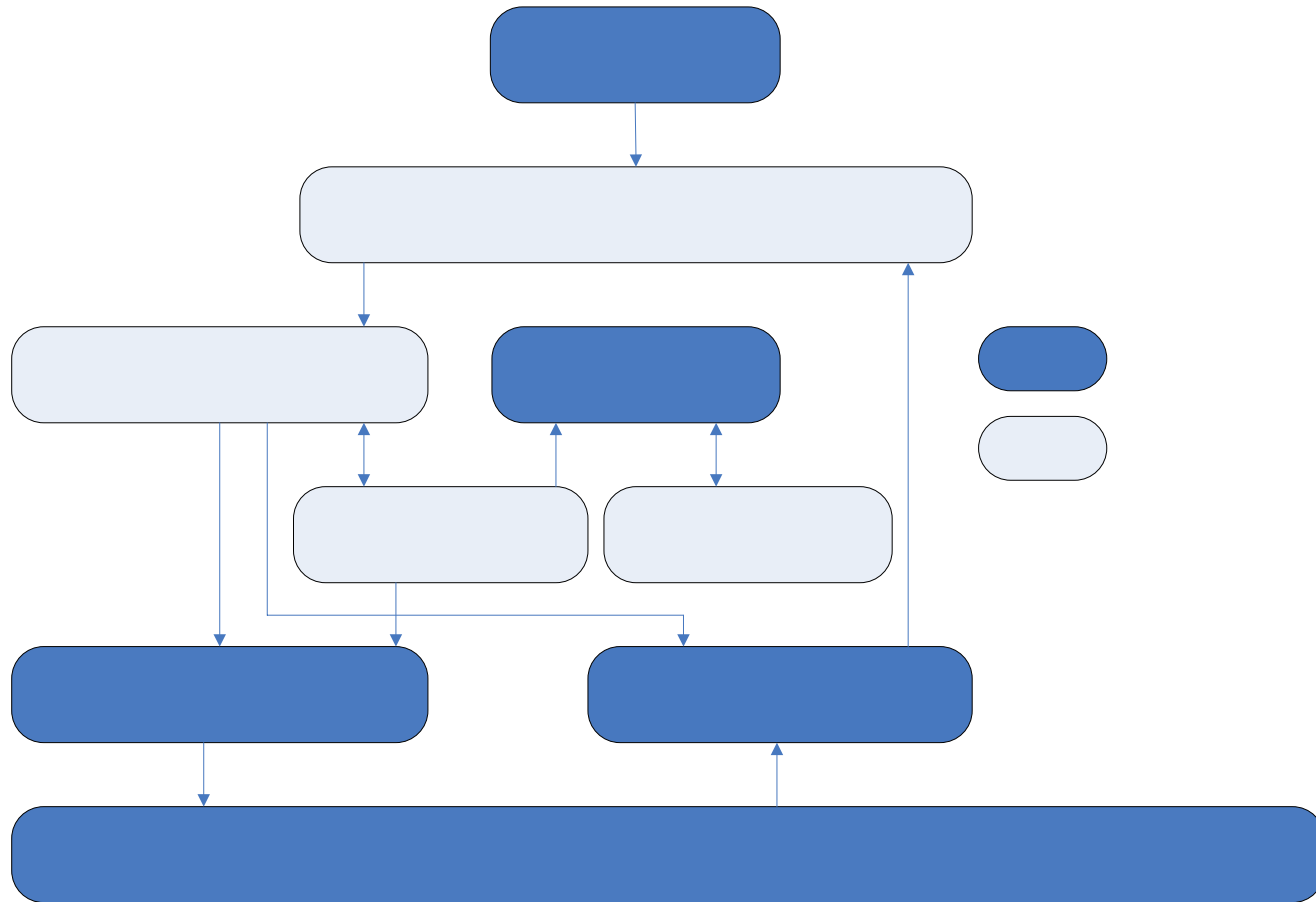
The OntoNL Framework

■ is able to address uniformly a range of problems in sentence analysis each of which traditionally had required a separate computational mechanism. In particular a single architecture:

  □ handles both syntactic and semantic ambiguities by using upper and domain ontologies

  □ handles ambiguity at both a general and a domain specific environment

  □ consults user profiles to personalize the disambiguation

The OntoNL Framework

- utilizes the rich structures that OWL provides to describe ontologies

- uses User Profiles to guide the semantic search in the domain ontology and to rank the results in a way a user meets his preferences

- we use it to create a Natural Language Interface for the domain of soccer that is used in a question answering system

The OntoNL Framework

Early results

- A multimedia (video) application within the domain of soccer has been selected to be used as a first demonstrator of the application.

- The natural language processing component developed an architectural framework, and progressed in the theoretical foundations of the approach.

- A detailed design of the natural language prototype system based on the above foundations exists. The aim of this prototype is to investigate the automation possible in the implementation of natural language interfaces to knowledge management systems.

- An implementation of a particular application based on the prototype has started and is progressing well.

The OntoNL Architecture
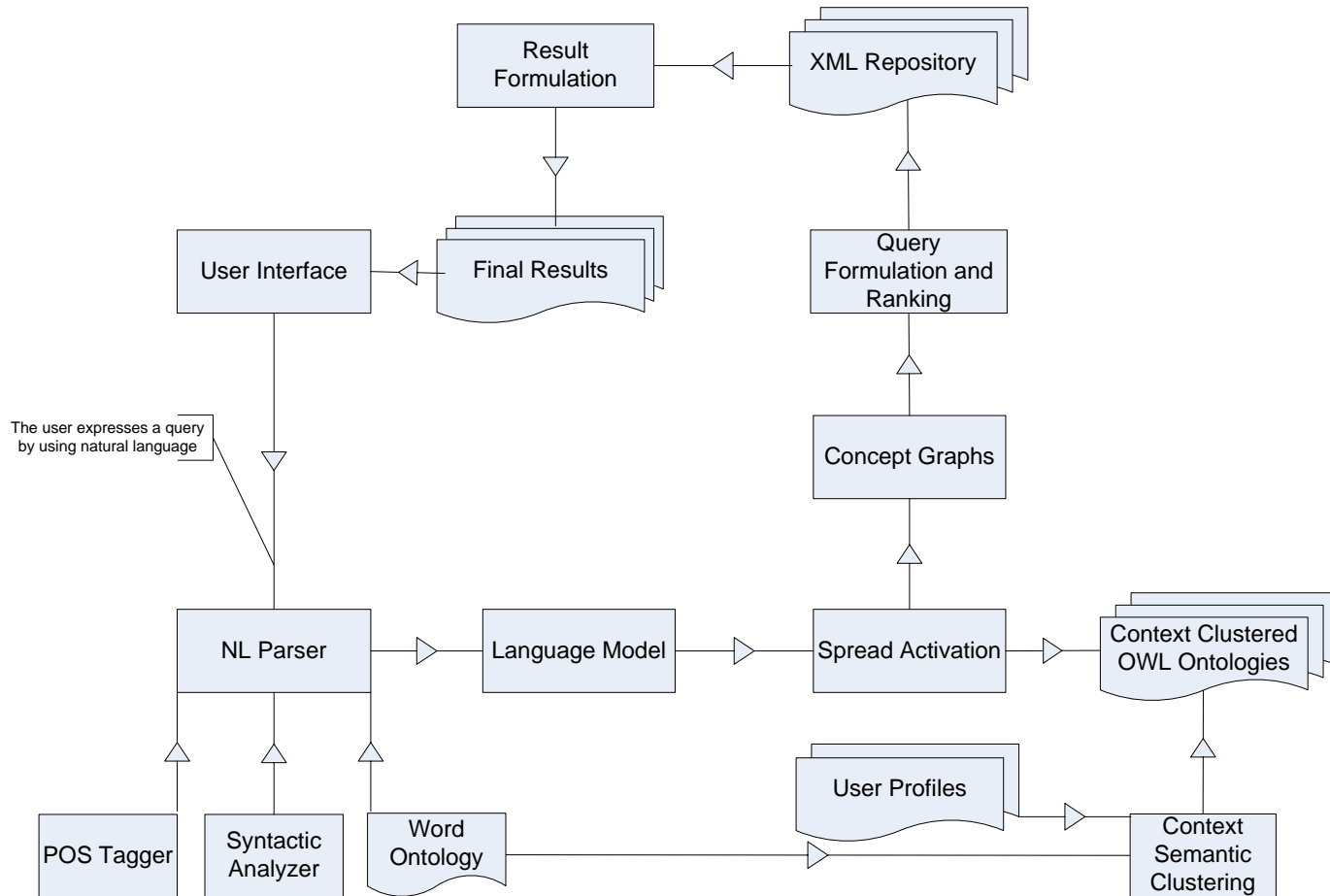
Speech Recognition
Keywords Spotting

- Keywords list – limited list of English or German words
- Acoustic model – cross-word triphone acoustic model for German or English languages
- Language model – language model is presented as a grammar which includes all used keywords and garbage model without limitation on the order
  - The grammar is regular expression created on the base of regular expression symbols
  - Garbage model – special language model for non-keywords represented as a grammar with a free phonemes order
- Output – output of keywords spotting is MPEG-7 document

Natural Language Parser

■ NL Parser uses

- ☐ the system of tree annotations from the <u>Penn Treebank</u> of English, which is a database of trees for about 50,000 English sentences

- ☐ a Java implementation of a maximum-entropy part-of-speech (POS) tagger. The POS tagging task is based on the Stanford Log-linear Tagger

- ☐ a noun compound bracketing mechanism with domain ontologies as the training set

Natural Language Parser

- ## NL Parser uses
  - □ a grammatical relation annotation scheme
    - Map the syntactic descriptions found in the sentence into the correct roles that the elements (described by the nominals) play in the situation at hand (described by the verb).

  - □ a thesaurus (WordNet), where the list of stem of nouns and verbs are refined to provide the system with semantics, like senses and synonyms of the basic concepts within the utterance

Language Model

SUBJECT
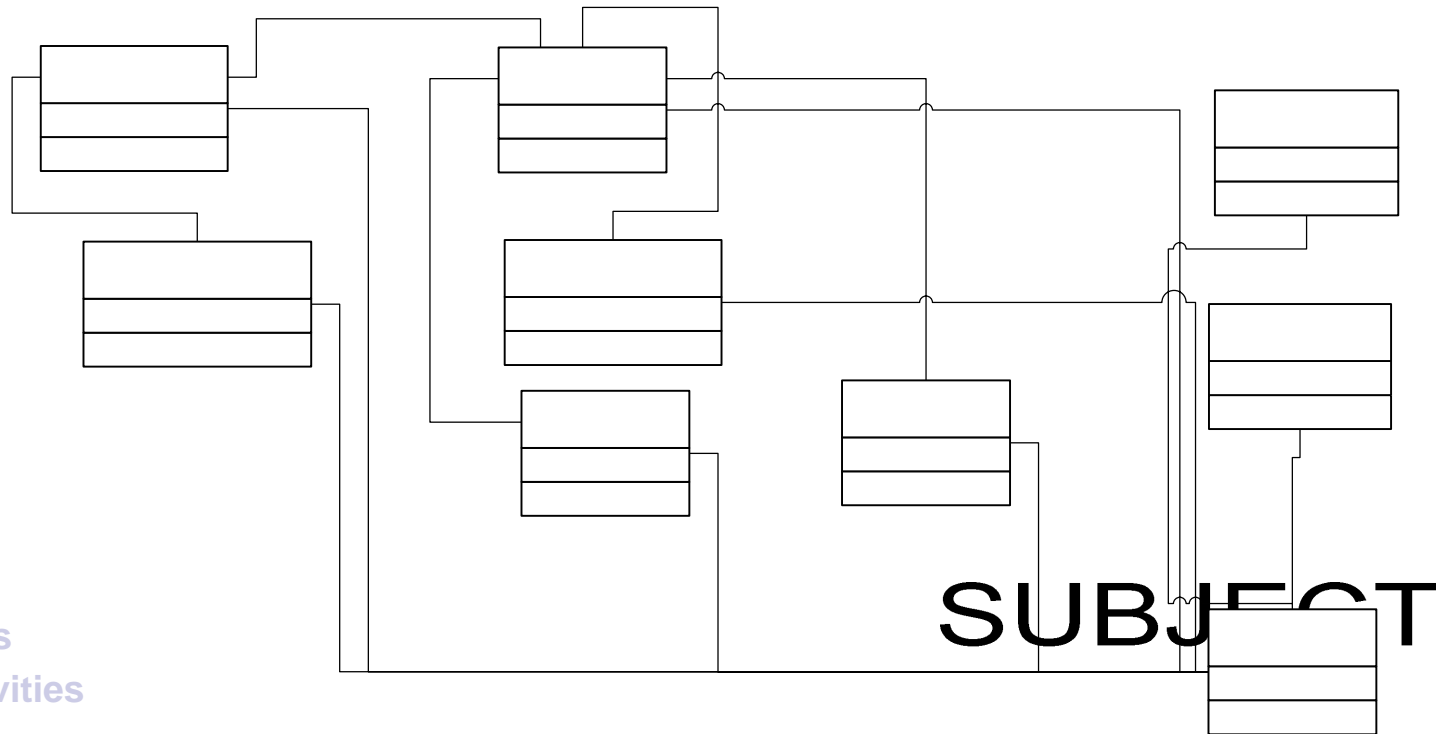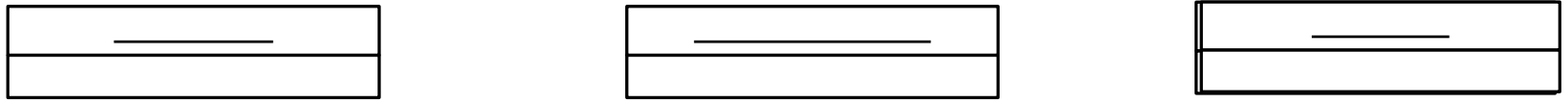
Language Model: An Example

'*The player with shirt number 9 gave Milan the victory*'
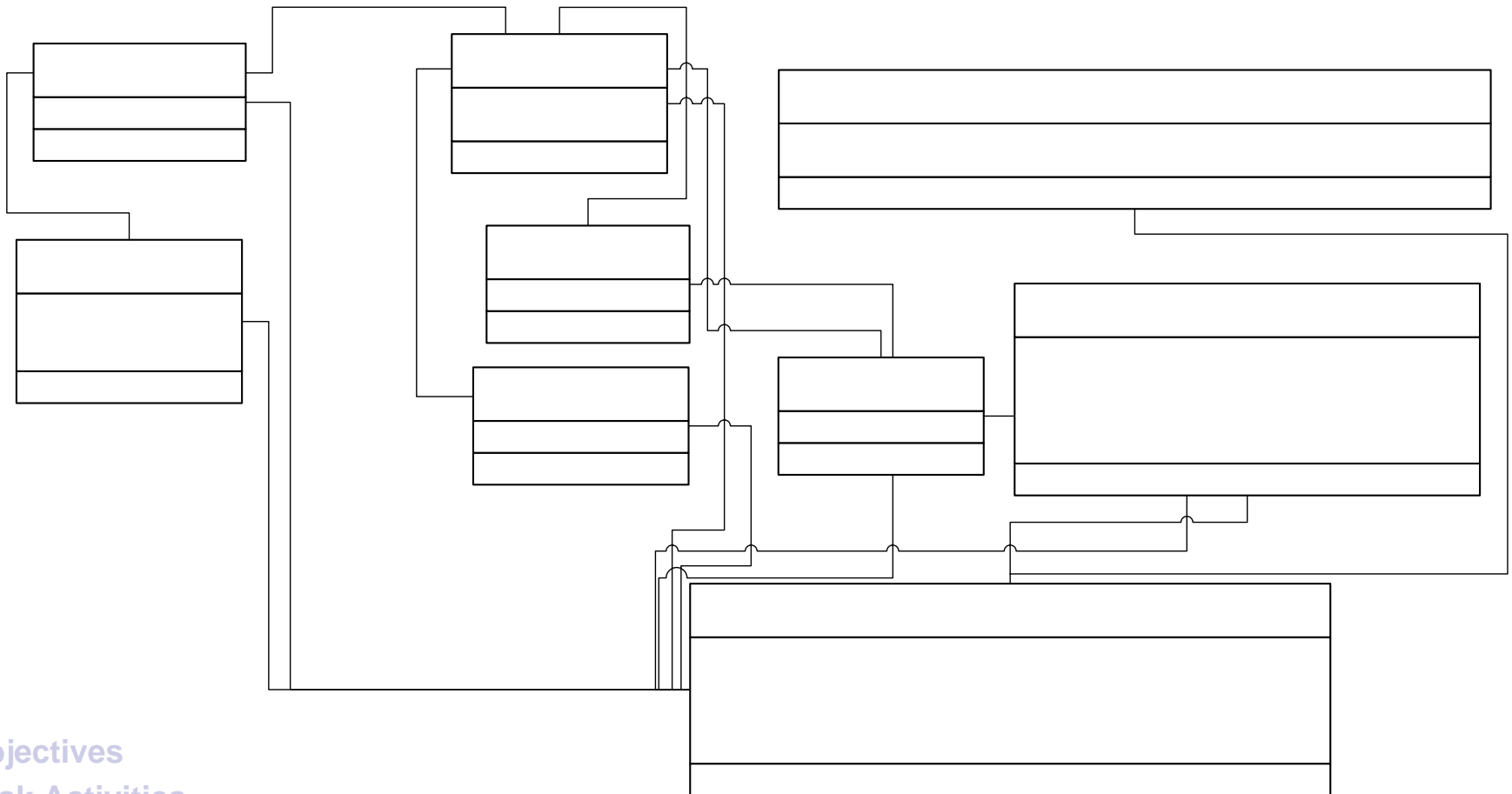
Publications

- Biatov K. and Larson M, *Speaker Clustering via Bayesian Information Criterion using Global Similarity Constraint*. The 10th International Conference Speech and Computer SPECOM 2005, Patras, Greece, 2005.

- Karanastasi, A., Christodoulakis, S. *OntoNL: An Ontology-based Natural Language Interface Generator for Multimedia Repositories.* In the Proc. of the 7th DELOS International Workshop on Audio-Visual Content and Information Visualization in Digital Libraries (AVIVDiLib'05)

- Karanastasi, A., Kazasis, F., Christodoulakis, S., *A Natural Language Model and a System for Managing TV-Anytime Information in Mobile Environments*, in the ACM/Verlag Personal and Ubiquitous Computing Journal, Volume 9, 2004

- E. Bertini, T. Catarci, S. Kimani and A. Dix, *A Review of Standard Usability Principles in the Context of Mobile Computing*, in Studies in Communication Sciences journal, 5(1), 2005.

Extensions

- Formal models in general environments to exploit contextual information on user preferences to reduce semantic and syntactic ambiguities and avoid clarification dialogues

- Generality of the approach as well as its performance in a different type of application

- Couple practical approaches of natural language with theoretical approaches of reasoning to produce new models for the construction of natural language interfaces to knowledge repositories

- Development of a robust front-end processing module to allow speech input in adverse conditions.

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