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An Incremental Architecture for the Semantic Annotation of Dialogue Corpora with High-Level Structures. A case of study for the MEDIA corpus.*

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Abstract

The semantic annotation of dialogue corpora permits building efficient language understanding applications for supporting enjoyable and effective human-machine interactions. Nevertheless, the annotation process could be costly, time-consuming and complicated, particularly the more expressive is the semantic formalism. In this work, we propose a bootstrapping architecture for the semantic annotation of dialogue corpora with rich structures, based on Dependency Syntax and Frame Semantics.

1 Introduction

We propose a cooperative architecture that incrementally generates and improves the annotation of the French MEDIA dialogue corpus with high-level semantics (HLS), as a result of the cooperation of several linguistic modules. MEDIA is a French corpus that has collected about 70 hours of spontaneous speech from the task of hotel room reservation. It contains transcribed utterances\(^1\) that have been manually segmented\(^2\) and annotated with a flat semantics i.e., concept-value pairs (Bonneau-Maynard et al., 2005).

\(^1\) Utterances with ellipsis, disfluencies, false starts, reformulations, repetitions and ungrammaticalities and special characters such as the symbol "*" that indicates uncertainty due to noise in the communication channel.

\(^2\) The term Segment means sequence of words in utterances.

The HLS semantics, namely the MultiModal Interface Language formalism (MMIL) (Denis et al., 2010), augments the expressivity of the flat semantics by representing communicative actions, predicates, arguments and fine-grained features. Communicative actions are components built up from two types of entity (i.e. events and participants), which are linked together by relations and described by sets of features (attribute-value pairs). It is possible to identify in entities a set of main features, which can be domain-specific. For the semantic annotation, components are mapped to segments in utterances. Figure 1 shows the canonical representation of an utterance in the corpus in compliance with the specifications for the annotation\(^3\).

2 The Architecture

The architecture (Figure 2) for the automatic annotation has been formulated as a post-interpretation process that takes place after the syntactic analysis and semantic role labeling (SRL). Two linguistic resources interact within the architecture, the corpus and the Frames\(^4\). Four linguistic modules are involved in the annotation: the Part-Of-Speech (POS) tagger, the parsing, the semantic-role labeling (SRL) and the HLS Builder. The common knowledge base comprises two knowledge-bases (one for the domain and the other for the HLS formalism) together with a relational database management system (RDBMS). The knowledge bases assure the coherence of the an-

\(^3\) http://www.port-media.org/doku.php?id=mmil_for_annotating_media

\(^4\) Frames is the process in which the frames and frame elements (FE) are defined.
Figure 1: HLS representation for the French utterance “je voudrais faire une réservation d’une chambre pour une personne à Niort” (So I would like to make a reservation for a room for one person in Niort). It shows a request to reserve: the communicative action is Request the main event is Reserve. Note that the beneficiary and the patient are two different roles, the beneficiary is the person, not necessarily the same speaker, who will use the object reserved (e.g. rooms). The patient is the speaker. The segmentation of the HLS Component is presented in the Table, the component is mapped to the whole utterance. The fine-grained segmentation of features is shown for the Participant 2.

Table 1: Static Characteristics of Frames in FrameNet and in PORT-MEDIA.

| FrameNet | PORT-MEDIA |
|----------|------------|
| Frames   | Lexical Units, Phrase Type and Grammatical Function | Lexical Units, POS tags and templates and dependency relation |
| Frame Elements | Lexical Units, Phrase Type and Grammatical Function, Semantic Type | Lexical Units, POS tags, templates and dependency relation, Semantic Type and MEDIA flat semantics |

Semantic Role Labeling. We built a rule-based semantic role labeling for detecting frames and FE (roles) by using dependency tree-template pattern matchers that exploit the information already compressed in frames. The SRL detects the boundaries of FEP and FE by measuring the syntactic and semantic similarity between the utterance and the frame.

HLS Builder. The HLS Builder is the last phase in the annotation process: it is rule-based and it takes utterances in the corpus with their flat semantics, de-
dependency trees and predicates-arguments and builds the HLS representation (See Figure 1), according to the specifications for the annotation and the knowledge bases. The dialogue act and main event in HLS components can be detected from the predicates. Similarly, secondary events and participants with their features can be detected from the roles and the flat semantics.

3 Evaluation and Discussion

For evaluating the system we separately computed the accuracy of its linguistic components. The parser achieved a label attachment score (LAS) (Nivre et al., 2007) of 86.16%, with a training set of 1097 utterances and a test-set of 100 utterances. The SRL was evaluated with metrics adapted from the CONLL 2005 evaluation (Carreras and Márquez, 2005) for supporting FEP and allowing overlapped FEP for different frames. The LAS was computed by comparing the semantic dependencies of system’s and gold’s propositions\(^6\) and their segments. The gold standard comprises 115 utterances annotated with the major frames in the domain: Request, Reserve and Attributes. The F1-measure computed for propositions with exactly the same segments was 56.66%. When verifying whether the segments contain the same syntactic governor, the SRL achieves a better score: 71.30%. Finally, varying the number of excluded words in both segments\(^7\) yielded a constant increase of the F1-measure until a maximum of 84.27%. The HLS annotation was evaluated by measuring the similarity between gold’s and system’s components with a gold standard of 330 complex utterances related to the reservation task. When rigorously measuring the equality of components\(^8\), we obtained a F1-measure of 57.79%. Measuring equality of components without being so rigorous with features’ segmentation, yielded a slightly higher score 63.31%. Finally, when measuring equality of components by taking into account only the main features of entities, we obtained a higher score: 70.65%.

We proposed an architecture for corpus management that allows incremental updates over persistent information until a more accurate semantic annotation is obtained. The preliminary results show a general agreement when defining the main features and the main entities in HLS components and a disagreement when segmenting fine-grained features. We observed that the system tends to create new entities when it detects repetitions or references in long utterances. Defining a more precise segmentation policy in the manual annotation guidelines, augmenting the training data for parsing, as well as integrating reference resolution and disambiguation techniques, will enhance the annotation process. An appealing research direction would be to integrate and evaluate machine learning components in the architecture.

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\(^6\)A proposition is a structure containing the predicate, their arguments and the semantic relation between them.

\(^7\)From 1 to \(n\) words not common in both segments.

\(^8\)Two HLS components are equal if their entities and relations are equal. Two entities are equal if they have the same segment and features (feature name and feature value) and if these features are mapped to the same segments in the utterance. Two relations are equal if they have the same source and target entities as well as the same name.