META-LEVEL CONSTRAINTS FOR LINGUISTIC DOMAIN INTERACTION

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Abstract

This paper presents a technique for the representation and the implementation of interaction relations between different domains of linguistic analysis. This solution relies on the localization of the linguistic objects in the context. The relations are then implemented by means of interaction constraints, each domain information being expressed independently.

1 Introduction

Natural language processing is faced with the question of integrating different sources of information, coming from different domains of linguistic analysis such as prosody, phonology, syntax, discourse, semantics, etc. It is then necessary to explain how such interaction is possible. Classical answers consists in representing interaction by means of direct relations between structures (for example between an intonative group and a tree). We propose in this paper a solution in which all information is localized by means of an *anchoring* system, the interaction itself being implemented with *interaction constraints*.

2 Interaction constraints

An important part of the problem consists in finding an interface point between domains more than an alignment between structures. The problem more precisely consists in finding a common point making it possible to indicate that two sets of properties refer to the same object. We propose to specify a feature describing a position for any information. Such localization can be a temporal, spatial or contextual indexation: it can be the time of an acoustic event in the signal, the position of a word into a sentence or the membership of an object to a discourse universe. We propose then to use an anchor which is represented by a complex feature described in (1a).

(1a)
$$\text{ANCHOR}\begin{bmatrix}\text{TEMPORAL}\ \langle i,\ j\rangle\\ \text{POSITION}\ \langle k,\ l\rangle\\ \text{CONTEXT}\ c\end{bmatrix}$$

(1b)
$$\text{OBJ}\begin{bmatrix}\text{DOMAIN}\ \mathit{synt}\\ \text{CHARAC}\begin{bmatrix}\text{CAT}\ \mathit{Det}\\ \text{ANCHOR}\begin{bmatrix}\text{TEMP}\ \langle 880,\ 1000\rangle\\ \text{POSITION}\ \langle 2,\ 3\rangle\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

The example proposed in (1b) gives a localization for a determiner both in the signal thanks to a temporal indexing and in the sentence. Such a multiple anchoring makes it possible to refer in different ways to the same object.

The implementation of *interaction constraints* controlling the interface between the linguistic domains relies on such anchoring. More precisely, it consists in expressing relations (typically cooccurrency) between objects coming from different domains and specified by means of a *characterization* (i.e. a set of properties) and an anchor. The following example shows an

interaction constraints implementing a relation described in [Bear90]. It stipulates that no major breaks can separate two juxtaposed sisters connected with a complementation relation ($\rightsquigarrow$). In such a constraint, an object simply has to be located and described by means of a characterization (that can be represented with any formalism).

(1) $$\left[\begin{array}{l}\text{DOM } synt \\ \text{CHAR } \left[\begin{array}{l}\left[\begin{array}{l}\text{CAT } c_1 \\ \text{ANCH } \left[\begin{array}{l}\text{TEMP } \langle t_1,\ t_2 \rangle \\ \text{POS } \langle i,\ j \rangle\end{array}\right]\end{array}\right] \\ \left[\begin{array}{l}\text{CAT } c_2 \\ \text{ANCH } \left[\begin{array}{l}\text{TEMP } \langle t_3,\ t_4 \rangle \\ \text{POS } \langle k,\ l \rangle\end{array}\right]\end{array}\right] \\ \text{DEP } c_2 \rightsquigarrow c_1\end{array}\right]\end{array}\right] \not\Leftrightarrow \left[\begin{array}{l}\text{DOM } pros \\ \text{CHAR } \left[\begin{array}{l}\text{CAT } break \\ \text{ANCH } \left[\begin{array}{l}\text{TEMP } \langle t_2,\ t_3 \rangle \\ \text{POS } \langle j,\ k \rangle\end{array}\right]\end{array}\right]\end{array}\right]$$

Interaction constraints can represent many different kind of information, in particular, multimodal relations. The following constraint implements a coreference relation represented with a conjunction. It involves three characterizations coming from three different domains: gesture, graphics and language. Such a relation occurs typically with weather TV broadcasts. The constraints indicates that a deictic gesture (see [Kettebekov02]), in a certain universe (noted C) at a given time, stipulates a coreference between an object specified in the language domain (for example a pronoun) at the same time position and a discourse referent from the graphical domain (for example a map) that belongs to the universe C.

(2) $$\left[\begin{array}{l}\text{DOM } gesture \\ \text{CHAR } \left[\begin{array}{l}deictic \\ \text{ANCH } \left[\begin{array}{l}\text{TEMP } \langle i,\ j \rangle \\ \text{CONT } C\end{array}\right]\end{array}\right]\end{array}\right] \wedge \left[\begin{array}{l}\text{DOM } lang \\ \text{CHAR } \left[\begin{array}{l}\text{SEM } \left[\text{REF } x\right] \\ \text{ANCH } \left[\text{TEMP } \langle i,\ j \rangle\right]\end{array}\right]\end{array}\right] \wedge \left[\begin{array}{l}\text{DOM } graph \\ \text{CHAR } \left[\begin{array}{l}\text{SEM } \left[\text{REF } x\right] \\ \text{ANCH } \left[\text{CONT } c_1 \in C\right]\end{array}\right]\end{array}\right]$$

3 Conclusion

This paper presents a technique making it possible to refer to any kind of information by means of a complex anchor feature. The possibility of indexing information on a temporal axis as well as a discourse universe allows to represent interaction relation independently from any formalism. Such a representation makes it possible to implement interaction between any kind of information coming from different domains.

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