Ontology-Based Information States for an Artificial Sales Agent

Núria Bertomeu
Centre for General Linguistics (ZAS)
Berlin, Germany
bertomeu@zas.gwz-berlin.de

Anton Benz
Centre for General Linguistics (ZAS)
Berlin, Germany
benz@zas.gwz-berlin.de

Abstract

This paper presents an approach to the representation of dialogue states in terms of information states and joint projects, on the basis of which we are modelling a non-player character (NPC) with natural dialogue capabilities for virtual environments.

1 Introduction

In order to gather data on how humans interact with NPCs we collected a corpus by means of a Wizard-of-Oz experiment consisting of 18 dialogues of one hour of duration (Bertomeu and Benz, 2009). We simulated a scenario where the NPC played the role of an interior designer and helped the customer furnishing a living-room. The following dialogue gives a glimpse of the data:

(1) USR.1: And do we have a little sideboard for the TV?
NPC.3: What about this one?
USR.5: Is there a black or white sideboard?
NPC.6: No I'm afraid not, they are all of light or dark wood.
USR.6: Ok, then I'll take this one.
NPC.7: All right.

Our investigation of the data aims at addressing questions relevant for the development of dialogue models for NPCs, e.g. which action should an NPC carry out given a particular context. For this, we need to annotate not only the actions performed by the dialogue participants (DPs), but also the changes that these actions produce in the information state (IS) shared by them. As the dialogue is oriented to the task of furnishing a room, the ISs must contain a partial domain model which keeps track of the objects selected so far, and of the topics under discussion. We will use here the term information state (IS) to denote the information which has been established during the dialogue: concretely, the parameter values already fixed and the parameter values under discussion and under consideration, similar e.g. to Ginzburg's Dialogue Gameboard[1] (Ginzburg, 1995).

We developed an annotation scheme from which the ISs and their updates can be automatically generated. Interestingly, the ISs are closely related to the ontology used for representing the domain objects, i.e. rooms, furniture, wall-covers, etc. The ontology-based domain model allows the NPC to change the order in which topics are addressed at any time according to the user initiatives, resulting thus in a more flexible and natural dialogue.

Regarding the annotation of ISs, Poesio et al. (1999) have carried out a pilot study for the annotation of ISs, concluding that these are not suitable for large-scale annotation, because the task is time-consuming and difficult. Georgila et al. (2005) have automatically annotated ISUs in the COMMUNICATOR corpus. However, since the content of ISs is domain and task-specific such a procedure is not easily transferable to our corpus.

2 Projects and information states

We took a bottom-up approach to the analysis by choosing as our annotation unit minimal joint projects (Clark, 1996). Minimal joint projects are adjacency pairs which have a purpose and carry out an update of the IS. Each adjacency pair divides into an *initiating* and an *completing* act. A joint project is annotated for its function, its goal, whether it contains embedded projects, the common IS, and the initiating and completing actions. The actions are further specified ac-

[1] It should be noted that the information states in the Information State Update (ISU) framework, e.g. (Poesio et al., 1999), are richer in content than our representations, since they contain information on the individual dialogue moves and representations of goals and agendas.

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cording to the act they perform and their role in the project, among other information. An example of an *initiating* act can be found in Fig. 1. The representation shows that the PARAMETER_UNDER_DISCUSSION addressed by the act is the location *l1* of a shelves item[2].

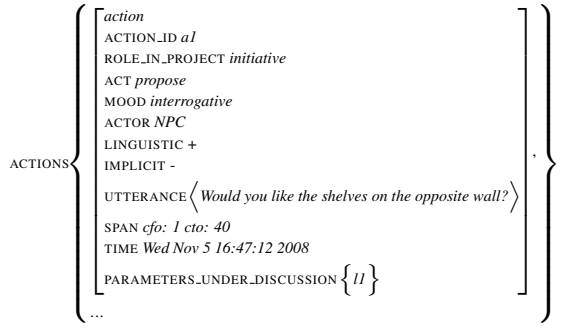

Figure 1: The initiating act related to the utterance: *Would you like the shelves on the opposite wall?*

The common IS will only be updated after a joint project has been completed. If the completing act of the addressee accepts the proposed location, the IS will be updated as shown in Fig. 2.

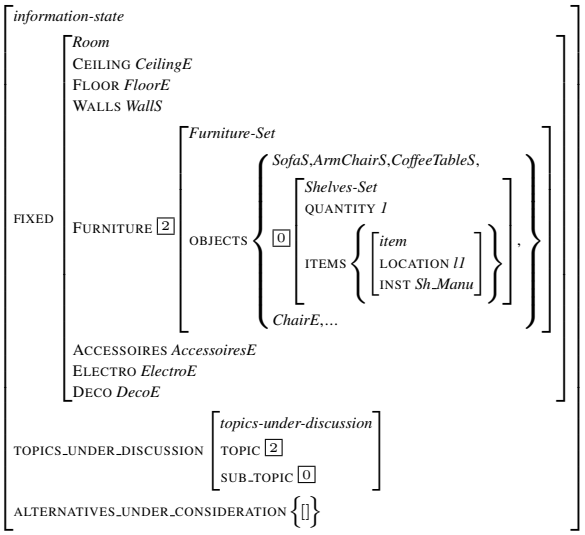

Figure 2: An information state

The value of FIXED is the feature-structure (FS) representation of a room as specified in the ontology. A room consists of different types of objects, such as furniture, decoration, etc. Furniture in turn includes sofas, arm-chairs, shelves, etc. The representation shows that *Shelves*, and thus *Furniture*, are currently under discussion. It also shows that the location of the chosen shelves has been fixed to be *l1*. *Fixing* information means agreeing on a value for a parameter. It may happen, though, that several values for a parameter are entertained simultaneously. This occurs e.g. if the user asks for another item of the same type without rejecting the item which has been under discussion before. Therefore, a set of ALTERNATIVES_UNDER_CONSIDERATION must be represented. Whenever an agreement is reached, this set is emptied.

The ISs are not annotated directly. They are automatically extracted from the annotation of the individual parameters addressed by the actions and the dialogue acts performed by those, and encoded in FSs following the TEI-P5 guidelines[3]. This procedure makes their annotation feasible.

3 Conclusion

For developing an artificial sales agent, we need a fine-grained representation of ISs and their updates. In particular, the topics under discussion and their discourse status as *open*, *fixed*, or *under consideration* are an essential aspect for planning a discourse strategy. We managed to develop an ontology-based format for representing ISs which is rich enough to fulfil these tasks, and came up with an annotation methodology which makes hand-coding feasible. For the future, an automatic extraction of a finite state description of the sales scenario is planned.

References

N. Bertomeu and A. Benz. 2009. Annotation of Joint Projects and Information States in Human-NPC Dialogue In *Proceedings of CILC-09*. Murcia.

H.H. Clark. 1996. *Using language*. Cambridge University Press. Cambridge.

J. Ginzburg. 1995. Resolving questions. *Linguistics and Philosophy*, 18:5, 459 – 527.

K. Georgila, O. Lemon and J. Henderson. 2005. Automatic annotation of COMMUNICATOR dialogue data for learning dialogue strategies and user simulations. In *Ninth Workshop on the Semantics and Pragmatics of Dialogue DIALOR*.

M. Poesio, R. Cooper, C. Matheson, D. Traum. 1999. Annotating conversations for Information State Update. *Dialogue*. Amsterdam University.

[2] *l1* is the id of the location referred to by '*on the opposite wall*'.

[3] http://www.tei-c.org/release/doc/tei-p5-doc/en/html/FS.html