

The Induction of Communication Protocols

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ABSTRACT

This thesis comprises three stages: (i) translating natural language conversations into marked up Agent Communication Language messages; (ii) analyzing the communicative behavior of online collaborators; (iii) inspecting the set of communication protocols of humans. The goal of the thesis are: (i) to correctly convert natural language conversations into agent communication language, following the specifications of FIPA-ACL; (ii) to understand how humans *learn* to *induce* communication protocols. In this paper, we present the first achieved goal: converting the conversations.

Categories and Subject Descriptions

H.1.2

General Terms

Theory, Human Factors

Keywords

Agent Communication, Situated Cognition, Activity Theory, Human Learning and Communication, FIPA-ACL

1. Activity States

We have converted about 40,000 word exchanges among computer scientists collaborating online (i.e. instant messaging and video conferencing) and have identified about 4,000 equivalent communicative acts (i.e. intentions). These conversations have been manually converted into marked up Agent Communication Language (following the Fipa-ACL formal specifications) using the activity states framework. The framework is inspired by the Cognitive Science studies, in particular; (i) Situated Cognition [3]; (ii) Activity Theory [4]; and (iii) Learning and Communication [2]. The activity states framework [1] main contribution is to provide for intermediary concepts that map natural language conversations onto an equivalent agent communication language. The fundamental idea is to allow the selections of communicative acts that best represents the “mental reflections” of the agent: associated to activities and situations the agent is situated in hence, being social. The framework looks into the (i) current activity he (we use he for he/her) is engaged in (i.e. what is my relationship with

what I was doing previously, presently and what I would like to do in the future); (ii) changes of context during the conversations (i.e. my process is influenced by external factors that had triggered me to change directions). These are used as guidelines for identifying beliefs, choice (i.e. desires) and uncertainty for recognizing *intentions*. It takes into consideration the activity states of the speaker and listener. The conversion steps involved are: (i) Step 1: Identified the different level of predicates using logical analysis. Denoted these results with *W*. (ii) Step 2: Re-structured *W* with Equational Logic (it contains symbols, predicates and equality) to structure it syntactically. We obtained several different types of models *M*. (iii) Step 3: Constructed functions and functors for *M*. Functions are used for mapping interpretation from one model to the other. Functors are used to map the changes of the performative function (denoted by *prf*) (i.e. how can I, will you) into equivalent communicative acts (denoted by *ca?*) (i.e. inquire, ask). (iv) Step 4: Used activity states to identify the beliefs, choice (i.e. desires) and uncertainty for recognizing the *intentions* obtained from model *M*. Later, this is associated to an equivalent communicative act defined in the FIPA-ACL formal model. (v) Step 5: Associated step 3 and 4. (vi) Produced the marked up ACL messages. The activity states framework contains one major process: *Conceptualization*. This term is borrowed from [3]; but at this stage of work, cannot be associated fully to the genuine term. The *activity* of the speaker (i.e. agent) like chatting, browsing links together, sending files to one another synchronously or asynchronously determines which sub-processes to call within the *Conceptualization*. The sub-processes are (i) Contextualize_1; (ii) Contextualize_2; and (iii) Re-coordinate. For example, in (i) this sub-process evaluates whether the activity of the speaker at the moment is similar to his previous activity at the previous moment. From here, we call *Reflect* and *Associate MD* (i.e. *MD* is one of the models *M*). During this phase, we then identify the beliefs, desires and uncertainty of the speaker in reference to his activity states (i.e. the conceptualization of his social context).

2. References

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