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Common Language Organization
by Multi-Agents

Tetsuo Ono

School of Information Science,
Japan Advanced Institute of Science and Technology

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Abstract

In this thesis, I propose multi-agent models, where agents come to organize a common language in the community through a number of exchanges of sentences between them. I study mechanisms of language fusion and language bifurcation by the models in computers. Furthermore, I consider a computational model of language acquisition.

First, I propose a *child* and *adult agent* model. In this model, I presuppose that a child agent who has a primitive grammar set is thrown into a community consisting of adult agents. The child agent modifies his/her grammar and learns a refined one, imitating adult's sentences, while the adult agents also loosen their grammar in order to accept what the child agent says tolerantly. I report the result of experimentation with this model, together with grammar representation and learning methods. I show that this model can realize adaptability, which is one of the important features of natural language.

Second, I propose an *inferable agent* model. In my artificial agent community, I hypothesize that each agent owns different grammar rules and has ability of *abductive* and *inductive* inference. In the early stage of the life-span of agents, they try to generate grammar rules abductively, to parse other's sentences, however in the later stage, they try to find rules inductively from a number of sentence examples they acquired so far. The communicative ability of agents is measured by *energy*. The energy score of each agent becomes high if he/she could recognize others' sentences, or his/her utterances could be recognized by others. According to this energy score, each agent changes his/her behavior; when the score is high, he/she can increase the chances of utterance, and can have more influence upon the grammar of the whole community. As each agent modifies his/her grammar by the inferences, the common grammar in the community keeps changing dynamically. In my computer simulation, I show that: (1) I can realize the adaptability and the robustness of the common grammar if I combine abductive/ inductive inferences, (2) the robustness is increased if I adopt the asynchronous community where the life-spans of agents overlap each other, and (3) the grammar fusion and the grammar bifurcation emerge by the larger-scale, longer-term experiment.

Finally, I propose a *word acquisition* model using a similarity-based method. In this method, the important notion to measure similarity among words and sentences is a mutual dependency of words and sentences. Agents calculate the similarity between words by the method. The agents are regarded as acquiring a word when they differentiate the word into clusters using the similarity. I explain a process of change of use of words in a multi-agent model.

Key Words: **fusion and bifurcation of language(s), GPSG, abduction, induction, similarity among words**