A Situated Approach to Cognitive Interaction Modelling

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Introduction

From a situated cognition point of view, an agent can not be seen independent of its environment. Hence, interaction should be modelled rather than individual agents. In this paper, four ways are discussed in which a model of an individual agent's behavior can be used to explain the behavior of another agent interacting with it. It is argued that only one of these approaches is reasonable: the one which uses a combination of abstract properties of the other agent's behavior and direct perception. This is illustrated with a case study on task sequencing in a learning task.

An example of teacher-student interaction

Suppose there are two agents. The task of one agent is to learn the translation of a set of words into, say, Japanese. We will call this agent the student. The student does not have a list of the word pairs; only through the other agent the words can be seen. The task of the other agent is to present a word to the student and ask for the translation. When the student has answered, this agent tells the student whether his answer was correct and, if not, what the correct answer is. We will call this agent the teacher. Suppose that the only thing the teacher may vary is the sequence of presentations: she may only determine the next word to present to the student. The rest is independent of the student's performance. The teacher has the assignment to try to let the student learn as efficiently as possible.

Focussing on one individual agent namely the student, this is a traditional paired associates task, and there are numerous models of paired associates learning. The question now is how these kind of models can be used to understand the behavior of the teacher.

Ways to use a model of an agent

There are four ways in which a model of an individual agent can be used to explain the (adaptive) behavior of another agent interacting with it. A first distinction is made between the use of an executable model by an agent to simulate the other agent, and the mere use of functional properties of a model. A second distinction is whether or not perception is regarded as an input to the process of deciding what to do next.

The use of an executable model has several disadvantages. Firstly, if the model is incorrect, then the information on which the choice for the next action is based is incorrect, and the action may turn out to be inappropriate. Secondly, it is difficult to determine the parameters of a model, and it is very likely that errors occur in this estimation process. Lastly, it takes a lot of computing power and time both to run the simulation of a model and to determine the parameters.

Combining an executable model with online-perception has as main advantage that this perception can be used continuously to adjust the parameters, which could reduce the effect of errors in the estimation of the parameters.

The use of only the functional properties of a model that are relevant for the interaction has as advantage that a strategy may be found that is optimal for various models, which diminishes the risk of using an incorrect model. However, the problem of using incorrect properties remains. Because the model does not have to be executed, no parameter estimation has to be done and no extensive computing power is required. However, without the use of online perception no adaptation can take place.

Combining the use of only the functional properties of a model with online-perception produces the only reasonalbe alternative.

A situated task sequencing strategy

We have designed a task sequencing strategy based on perception and simple hypotheses about how a student learns that can be abstracted from the existing learning models (Masthoff & VanHoe, 1996). Several well-controlled experiments have been done to provide experimental evidence that the situated task sequencing strategy gives better results than other strategies because of its adaptivity (Masthoff, 1996).

References

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