

“Gießener Abendgespräche Kognition und Gehirn“

Mittwochs, 18.00 bis 20.00 Uhr, Raum F009

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“f-ACT-R: Towards Rejecting Psychological Theories Using Symbolic Cognitive Models”

Rebecca Albrecht, M. Sc.
(Universität Freiburg)

I present preliminary work on a new approach to evaluate psychological theories assuming certain cognitive architectures. This approach is based on formal methods and removes the need for simulation. Therefore, it allows for either the automatic synthesis of cognitive models from empirical data and assumptions about human cognitive processes, or the rejection of psychological theories for given cognitive architectures. Today, cognitive models are often used to evaluate the plausibility and empirical adequacy of psychological theories. Basically, cognitive models are implementations of psychological theories which yield predictions on, e.g., response times, error rates, or bold responses. The advantage of using an implementation over an informal representation is that all assumptions need to be stated explicitly and consistently. In order to assess the quality of a cognitive model, its predictions are compared with empirical data. The ability of a cognitive model to predict empirical data drastically depends on the number of degrees of freedom in the model (free parameters). Usually an implementation of a psychological theory does not specify every detail necessary to define a complete and consistent cognitive model. In order to reject a psychological theory for a given cognitive architecture, all implementations of this theory need to be tested. Using a simulation based approach this is impossible. We propose the application of formal methods in the development and evaluation process of hybrid cognitive models. We focus on models defined in the ACT-R (Adaptive Control of Thought - Rational) cognitive architecture. The presented approach is two-fold. Firstly, the psychological theory is translated into an abstract model. The abstract model specifies assumptions from the psychological theory. Secondly, the abstract model is translated into a first-order logic formula which is satisfied if and only if there exists an implementation such that empirical data is predicted. If the formula is unsatisfiable, the theory can be rejected for the given cognitive architecture. If it is satisfiable, the results of the formal analysis can be used to infer an implementation that can be simulated.