# Report on the Third International Conference on Cognitive Modelling

23-25 March 2000
Groningen (Netherlands)

*Maarten van Someren*
*Universiteit van Amsterdam*

The International Conference on Cognitive Modelling has grown out of several European workshops on SOAR (the "EuroSOAR" workshops), a first general European workshop on cognitive modelling in Berlin, 1997 and second European workshop in Nottingham in 1998. Because the attendance of these events grew to about 100 persons in Groningen and because it attracts much attention from the US it has been renamed International Conference on Cognitive Modelling. Unlike conferences on cognitive science, the Cognitive Modelling conference has a rather strict methodology. Contributions must approximate the ideal of a running computer model, validated against empirical data and with a clear message that is relevant for cognitive psychology. Human learning has been a source of inspiration for machine learning, following the paradigm of Artificial Intelligence in which intelligent human behaviour guides the development of computational methods. From the perspective of MLNET it was interesting to see if it is possible to re-establish links with research on human learning. A notable property of this conference is that, although it has a strong psychological orientation, it includes almost no connectionist models.

The conference consisted of two invited talks, by John Anderson and Axel Cleeremans, and 32 papers, selected out of 65 submissions. The presentations covered a wide range of topics. Anderson pointed out an interesting dimension along which studies of human performance vary: the time scale. Some models concern processes that last tens to hundreds of milliseconds where at the other extreme processes are studied that last hours to days. Anderson proposes to distinguish six levels, each with different processes. For example, there is a difference between very fine-grained learning processes that take only seconds and more high-level learning which takes minutes or even hours. Different mechanisms are responsible for these different types of learning but also they are likely to happen in parallel and they may influence each other. Anderson's ACT-R model of human cognition was a dominant factor in the conference. ACT-R is a computational model of the human cognitive architecture. It involves a model of basic memory structures ("chunks" with links to other chunks), storage and retrieval processes and skill acquisition mechanisms. Many of the assumptions in the model are contentious but Anderson and his group and a growing number of researchers in Europe make a serious effort to support the assumptions by empirical research or replace them by other assumptions when they are falsified. About 11 of the 32 papers used the ACT-R model as their basis. This is because it is the most elaborate computational model of human cognition and because an implemented version is freely available. A model for a particular phenomenon can thus be constructed by "filling" the ACT-R architecture with knowledge relevant for the task. Most papers concerned extensions of ACT-R, in particular to visual perception. During the conference there was a session in which extensions to the architecture were discussed and plans were made for changes to be made in the next release of ACT-R.

Building models in ACT-R forces the researcher to give an answer to questions that other computational models allow one to avoid. For example, a cognitive model of a reasoning process must make explicit assumptions about perception in the task and also about learning.

Axel Cleeremans discussed some experiments on "implicit learning". People learn many things without being aware of it. In many experiments people even deny that they have learned anything although their behaviour proves that they did. The relation between "conscious" and "implicit" learning is intriguing. Recent experiments address the question which types of structures can be learned "implicitly" and what this means for the architecture. His ideas about the architecture were strongly based on connectionist models and stimulating talk that gave the "symbolically oriented" audience the feeling that they really should listen again to the connectionists. And in fact, after the conference, the "community" of ICCM decided to make an attempt to include connectionist research in the next conference.

The presentation that I found most impressive was by Deb Roy from MIT MediaLab. He constructed a system with a visual and sound sensors. The system takes as input parallel visual and sound streams. The goal is to model perceptual learning in infants and the input to the system were visual and sound recordings from an infant playing with objects with its mother. The system searched for repeating patterns in the sound and image streams and in particular for co-occurring patterns. It then learned to associate sound patterns with visual patterns and in this way it learned words with their meanings. The system included a speech synthesis component modelling the infants attempts to name visual objects. The errors that the system made were very human. Analysis of the recordings of mother-child play showed that only 20 % of the utterances of the mother were the correct word for what the child was looking at and yet the model acquired most of the correct words. This model was purely functional. The methods that were used claims no structural validity for human learning but only weaker functional equivalence but from a Machine Learning viewpoint, the result was impressive. Also the task is interesting because it is both easier and more complicated than learning lexical knowledge from (spoken) text only.

From a machine learning viewpoint, the studies of the human cognitive architecture are not always interesting. In a machine learning context, the architecture can be selected or constructed. For cognitive modelling it is given. Some impressive human intelligent behaviour is the result of prior knowledge and experience rather than the architecture and at this conference the dominant theme was the architecture. In fact, one can distinguish two main types of studies among the papers at ICCM: "*Simon's ant" studies* and *architectural studies*. Simon's ant studies demonstrate that some interesting behaviour can be explained from factors in the task in combination with prior experience making only weak assumptions on the cognitive architecture. An example is the paper by Croker, Pine and Gobet that explains a phenomenon in language development basically from structures in the learning data. Like previous Simon's ant studies, this model shows that a very complex explanation devised by psychologists is not necessary to explain this phenomenon. Architectural studies focus on an assumption in the architecture and search for evidence on this in a task setting that involves only minimal knowledge.

From the perspective of Machine Learning I think that the most interesting ideas at ICCM were the tasks that involve learning in the context of some performance task. This provides interesting possible application settings, possibly with new research issues. The other way

round, I think that strictly for learning tasks, current machine learning methods are computationally much more powerful than the psychological models.

Several projects are underway in which simulation models are applied for practical purposes, in particular for evaluating and optimising human-computer interfaces and in collaborative tasks. Following up on a successful application of SOAR in simulating the behaviour of air force pilots, ACT-R systems are used to assess the probability of errors and the time needed to perform a task with different interfaces or different versions of cognitive tasks. This relies on recent extensions of ACT-R with visual perception and a simple motor component.

The conference was organised by Niels Taatgen (University of Groningen) and Jans Aasman (KPN Research) and took place in a very pleasant atmosphere at the university of Groningen. The next ICCM conference will be in Fairfax USA (George Mason University) in July 2001. (The Cognitive Science Conference will be in Europe that year!).