ACT-R as a Unified Architecture of Cognition: A Symposium in Honor of John R. Anderson

Organizers: Kevin Gluck (kevin.gluck@mesa.afmc.af.mil) Air Force Research Laboratory
Wayne D. Gray (grayw@rpi.edu) Rensselaer Polytechnic Institute

This symposium highlights the utility of the ACT-R theory as a tool for basic and applied cognitive science research. Four colleagues of this year’s Rumelhart Prize winner, John R. Anderson, will describe how his ACT-R theory has enabled and inspired their research.

An Activation-Based Model Of Sentence Processing As Skilled Memory Retrieval
Richard Lewis (rick1@umich.edu)
University of Michigan

This talk presents a theory and ACT-R-based model of human sentence comprehension that embodies the following claim: Sentence comprehension consists of a series of cue-based retrievals from short-term (and long-term) memory, subject to similarity-based interference and activation decay. ACT-R does not merely serve as an implementation language for the theory; rather it serves as the vehicle for bringing sentence processing into detailed contact with general and independently established principles of memory and skilled behavior. These principles, together with some representational assumptions from linguistic theory, provide explanatory accounts of many parsing phenomena (such as difficulty on embeddings and locality and recency effects), and generate novel predictions which can be empirically tested. Experimental work on several languages is summarized. The work includes experiments that examine the effects of interference and decay on distinct components of sentence processing, experiments that distinguish activation decay and distance-based accounts, and experiments that begin to answer one of the basic questions motivated by the theoretical framework: exactly what kinds of similarity (syntactic, semantic, phonological, positional) matters in sentence processing?

This is joint work with Shravan Vasishth, Julie Van Dyke, and JJ Nakayama. No linguistic or psycholinguistic background will be assumed.

Information Foraging Theory And The Rational Analysis Of Human-Information Interaction
Peter Pirolli (pirolli@parc.xerox.com)
Xerox PARC

Information foraging theory has been developed to provide rational analyses of how people adapt to the task of obtaining useful information to meet their ongoing goals, and how technology can be better designed to improve human-information interaction. Several ACT-R models have been developed to model human-information foraging theory. The information foraging approach will be illustrated by recent models of interaction with the Web.

ACT-R and Driving
Dario D. Salvucci (salvucci@cs.drexel.edu)
Drexel University

As a complex but ubiquitous task, driving serves as an excellent domain for both testing and applying cognitive architectures such as ACT-R. For several years we have worked to model driver behavior in ACT-R with two main branches of research. First, we have developed a computational integrated driver model that navigates realistic highway environments, accounting for various aspects of driver behavior including eye movements between regions of the visual environment and steering profiles through curves and lane changes. Second, we have worked to predict the potential for driver distraction from secondary tasks such as dialing cellular phones or even primarily cognitive tasks. Both lines of research are helping to shape a more general theoretical account of human multitasking within the ACT-R architecture, and at the same time, demonstrating how such architectures can facilitate the development of practical tools that infer driver intentions and predict driver distraction for new in-vehicle devices.

Embedded Cognition through Production Compilation
Niels A. Taatgen (taatgen@cmu.edu)
Carnegie Mellon University

Embedded cognition refers to the fact that our reasoning processes are not only driven by plans and goals in our heads, but also, or maybe even mainly, by interacting with the environment. The challenge is to develop a cognitive system that strikes the right balance between being driven by its internal goals and by opportunities in the environment. In order to explore this challenge, we have looked at a particular subdomain: following instructions. In experimental tasks participants typically are given instructions in a list-like fashion. For many tasks, strictly following the instructions will lead to brittle and rigid behavior. We will look at two examples that represent two ends of the spectrum of complexity: a basic dual-task and a complex real-time dynamic task. Both tasks have been modeled in the ACT-R cognitive architecture using the production compilation mechanism to achieve embeddedness.