Cognitive Simulation in the Large

Kenneth D. Forbus (forbus@northwestern.edu)
Computer Science and Education
Northwestern University
1890 Maple Avenue, Evanston, IL 60201, USA

One of the most exciting directions in cognitive simulation is exploring larger-scale phenomena. Now it is possible to tackle phenomena that would have been impossible even a few years ago, due to the confluence of three factors: progress in modeling basic cognitive processes, dramatic increases in computational power, and the availability of large-scale representational resources. This talk will discuss some methodological issues raised by larger-scale simulations, and some examples of larger-scale simulations that our group has created. Work in progress on Companion Cognitive Systems, a new architecture which use structure-mapping centrally in reasoning and learning, exploiting a million-fact subset of the Cyc knowledge base and cluster computing, will also be discussed.

How Practice Makes Perfect

Michael C. Mozer (mozer@colorado.edu)
Computer Science and Institute of Cognitive Science
University of Colorado

Although human learning is typically viewed as a phenomenon that occurs on a time scale of days or weeks, experimental evidence suggests that our second-to-second experiences have significant, long lasting effects on cognition and neocortex. For example, in behavioral studies of _repetition priming_, processing of a stimulus becomes more efficient as a result of prior presentation of the stimulus; neuroimaging studies robustly demonstrate _repetition suppression_, a stimulus-specific decrease in neural activity resulting from mere exposure; and neurophysiological studies have observed rapid changes to neural representations that underlie repetition suppression and that indicate improved discriminability in the face of noise. We interpret these ubiquitous adaptation phenomena via models at two different levels of abstraction. In a neural model, we propose an unsupervised learning mechanism that achieves an item-specific gain of neural responses. In a dynamical probabilistic model, we characterize changes to the time course of information transmission with experience. Through these complementary models, we obtain an understanding of how practice leads to the refinement of cognitive and motor skills.

This work is a joint collaboration with Michael Colagrosso, David Huber, Todd Mytkowicz, and Richard Zemel.