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Journal of Artificial General Intelligence
Special Issue on
Model Comparison for Cognitive Architectures and AGI

The purpose of this special issue is to explore the merits of a comparative approach for understanding Artificial General Intelligent (AGI) systems. This approach is common in the field of cognitive modeling, where different theories of cognition are instantiated as computational architectures and applied to common tasks to establish to their respective scope and limits. Within the field of cognitive modeling, comparison efforts have been recognized as crucial for making scientific progress, and the method is now finding its way into a number of related fields in cognitive science. But model comparison need not be viewed only as a theoretical exercise; in fact, the drive to implement unified theories of cognition as computational architectures and test them against a range of human performance data in dynamic, complex and potentially ill-structured task environments is, at root, no different than the call to develop AI systems that can generalize beyond narrow, task-specific applications. In this light, we view model comparison as a means to advance both cognitive science and the study of AGI systems and to reconcile traditions that historically emerged as complementary but have since evolved, for all practical purposes, as independent disciplines.

The structure and content of this special issue are influenced by a particular model comparison challenge recently organized to explore a generic dynamic decision making task, the Dynamic Stocks and Flows (DSF) (please see: http://www.cmu.edu/ddmlab/modeldsf for details). The DSF task was designed to be as simple and accessible as possible to computational modelers while focusing on two key ubiquitous components of general intelligence: the control of dynamical systems and the prediction of future events. A general call for participation was submitted to invite independent modelers using distinct computational approaches to simulate human performance in DSF. Participants in this challenge developed computational models to simulate human performance on the DSF task in a variety of conditions. The goal was to reproduce human behavior, including learning, mistakes and limitations in a way that would generalize to *new* conditions of the task undisclosed to the modelers. Results from three of the models submitted were selected for presentation at the 2009 International Conference on Cognitive Modeling. Human learning data in DSF as well as the results from all the models participating in the model comparison are available on the comparison web site and can be used for the purposes of analyses and publication in this special issue.

We welcome submissions from those who participated in the DSF model comparison challenge as well as from those who are in a position to comment on the following general topics relevant to model comparison within the context of the DSF challenge:

- Many computational fields have seen the emergence of challenge tasks to prod the development of new techniques and measure their progress toward the goal (e.g., Robocup). What are the requirements of such challenge tasks for AGI? Should they provide independent tests of specific capacities, integrated tests of functionality, or both?

- Progress is often measured on the relative evaluation of alternatives in a common setting. But what are the constraints of such comparisons for cognitive models? Are acceptable mechanisms limited to those that are judged cognitively - or even biologically - plausible? Should the complexity of a model be taken into account? Which levels of description are acceptable? Should models aim to predict human performance in new conditions, or is suitable post hoc reproduction of known performance data sufficient?
- The methodology developed by cognitive psychology for evaluating fits of model to human data is strongly dependent upon experimental control and scales poorly to complex, open-ended tasks. Sets of criteria for evaluating cognitive architectures have been proposed, but specific instantiations on AGI-level tasks have been lacking.
- Human behavior models based on cognitive architectures are usually developed for very specific tasks and at substantial effort to the modeler. While cognitive architectures keep being refined, cumulative progress in the form of model reuse has been elusive. New mechanisms and/or practices for composing and/or generalizing models of simple tasks are required for scaling up to models suitable for general, open-ended intelligence.
- Despite their stated goal of providing an integrated theory of human intelligence, specific cognitive architectures are usually applied to a relatively narrow set of cognitive activities, often laboratory tasks. Attempts to apply cognitive architectures to open-ended, naturalistic environments (using virtual or robotic embodiments) have raised substantial issues about their robustness and scalability beyond laboratory environments.

Submission

Submissions should be sent by **December 1st**, **2009** to DSFChallenge@gmail.com. Manuscripts should conform to the JAGI formatting guidelines that can be found at the journal's web site, http://journal.agi-network.org/, and should not exceed **20** pages of total length. Manuscripts will be submitted to a traditional anonymous peer-review process with publication of accepted contributions expected by summer 2010. Authors will be required to provide the final camera-ready, formatted and copy-edited manuscript. Inquiries regarding this special issue can be sent to DSFChallenge@gmail.com or directly to any of the special issue editors at the addresses below.

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