Tutorial: Building an MGLAIR Agent

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Description of the Tutorial

MGLAIR (Modal Grounded Layered Architecture with Integrated Reasoning) is a multi-layered cognitive architecture for embodied agents operating in real, virtual, or simulated environments containing other agents. The layers are organized along a mind-body axis. The highest layer, the Knowledge Layer (KL), implementing the mind, contains the beliefs of the agent, and is the layer in which conscious reasoning, planning, and act selection is performed. The lowest layer, the Sensori-Actuator Layer (SAL), contains the controllers of the sensors and effectors of the hardware or software robot. Between the KL and the SAL is the Perceptuo-Motor Layer (PML), which grounds the KL symbols in perceptual structures and subconscious actions, contains various registers for providing the agent's sense of situatedness in the environment, and handles translation and communication between the KL and the SAL.

MGLAIR evolved from the SNePS knowledge representation and reasoning system. An acting system was added to account for the fundamental differences between acting and reasoning, and to allow for agents that combine the two. GLAIR developed as an investigation of the mind-body distinction and of mind-body coordination, especially the origin of some beliefs in perception and proprioception. MGLAIR is an extension of GLAIR with a model of concurrent multimodal sensing and acting that distributes the agents various afferent and efferent capabilities among different modalities. A single modality is a limited resource, but different modalities are independent of each other and can be used concurrently.

This two-session tutorial will build on the MGLAIR keynote and discuss the technical issues involved in building an MGLAIR agent. Among the topics to be presented are: specifying modalities; designing the PML—mind-independent sublayers, and body-independent sub-layers; perception—connecting PML structures to KL terms; primitive acts, and placing them in modalities; intensional semantics—the semantics of KL terms; the deictic center—"I", "you", "here", and "now"; the syntax and semantics of non-primitive acts; agents with and without models of time; belief revision, and why it matters.

Examples of existing MGLAIR agents will be discussed, and opportunities for further research and development of MGLAIR will be mentioned.

Biographical Sketch of the Tutor

Stuart C. Shapiro is Professor Emeritus of Computer Science and Engineering and Affiliated Professor Emeritus of Linguistics and of Philosophy at the University at Buffalo, The State University of New York. His primary research interests are in knowledge representation and reasoning, natural language understanding and generation, cognitive robotics, and cognitive architectures. With his colleagues and students, he designed and implemented the SNePS knowledge representation, reasoning, and acting system, and the GLAIR and MGLAIR cognitive architectures.

Before retiring from teaching in January of 2012, Prof. Shapiro taught undergraduate and graduate courses in computer science for 41 years, primarily on knowledge representation, computational linguistics, cognitive science, and programming languages. He is editor-in-chief of The *Encyclopedia of Artificial Intelligence* (John Wiley & Sons), co-editor of *Natural Language Processing and Knowledge Representation: Language for Knowledge and Knowledge for Language* (AAAI Press/The MIT Press), author of *Techniques of Artificial Intelligence* (D. Van Nostrand), *LISP: An Interactive Approach* (Computer Science Press), *Common Lisp: An Interactive Approach* (Computer Science Press), and author or coauthor of more than 250 technical articles and reports.

Prof. Shapiro is a past Chair of ACM/SIGART; past President of KR, Inc.; a Life Senior Member of the IEEE; an ACM Distinguished Scientist; and a Fellow of the AAAI.