Topic:
The CLARION Cognitive Architecture

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Link: http://www.cogsci.rpi.edu/~rsun/clarion.html

Abstract:
This tutorial introduces CLARION, a dual-process/dual-representation cognitive architecture that centers on the distinction between explicit and implicit cognitive processes. CLARION is neural-network-based, and composed of four main subsystems: the Action-Centered Subsystem (ACS), the Non-Action-Centered Subsystem (NACS), the Meta-Cognitive Subsystem (MCS), and the Motivational Subsystem (MS). The ACS is mainly for action decision-making. The NACS is a slave system to the ACS and is used to store declarative and episodic knowledge. It is also responsible for reasoning in CLARION. The MS is responsible for determining motivational drive levels. The MCS is responsible for cognitive monitoring and parameter setting in both the ACS and NACS, and makes the goal setting determinations based on drive levels from the MS.

In addition, CLARION is based on two other basic theoretical assumptions: representational differences and learning differences of two types of knowledge: implicit versus explicit. The main difference between these two types of knowledge is accessibility. In each subsystem, the top level contains explicit knowledge (easily accessible) whereas the bottom level contains implicit knowledge (harder to access).

Explicit knowledge is represented using symbolic, localist representations; implicit knowledge is represented using distributed representations. The inaccessible nature of implicit knowledge is captured by distributed representations (in the bottom level), because representational units in a distributed representation are capable of accomplishing tasks but are less individually meaningful. This accords well with the relative inaccessibility of implicit knowledge (as shown by psychology). In contrast, explicit knowledge may be better captured in computational modeling by localist representations (in the top level), in which each unit has a clearer conceptual meaning. This captures the property of explicit knowledge being more accessible.

The second theoretical assumption concerns the different learning processes in the two levels. In the bottom level, implicit associations are learned through gradual trial-and-error learning. In contrast, learning of explicit knowledge is often one-shot and represents the abrupt availability of knowledge . The inclusion and emphasis on bottom-up learning (i.e., the transformation of implicit knowledge into explicit knowledge) is, in part, what distinguishes CLARION from other cognitive architectures. Nevertheless, top-down learning is also carried out in CLARION: Knowledge that is initially explicit can be

assimilated into implicit knowledge (to capture proceduralization and automatization found in human psychological data).

CLARION is capable of capturing a wide range of cognitive processes, as well as providing theoretical integration and interpretations of many psychological functions and processes. It has been used to capture numerous tasks. CLARION may also be a useful tool for building cognitively-oriented intelligent systems.

This tutorial presents a detailed description, along with many cognitive simulations, and formal results. Prior exposure to artificial neural networks can be helpful, but prior understanding of cognitive architecture/psychological modeling is not required. This tutorial will enable participants to apply the basic concepts, theories, and computational models of CLARION to their own (cognitively-oriented) work.

For more information, see: http://www.cogsci.rpi.edu/~rsun/clarion.html