Cognitive/Virtual Human Architecture

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The goal of this effort is to develop a *functionally elegant*, *grand unified*, *cognitive architecture* in support of virtual humans (and hopefully intelligent agents/robots – and eventually even a new form of unified theory of human cognition – as well).

A cognitive architecture is a hypothesis about: (1) the fixed structures that provide a mind, whether in natural or artificial systems; and (2) how they work together – in conjunction with knowledge and skills embodied within the architecture – to yield intelligent behavior in a diversity of complex environments.

A functionally elegant architecture yields a broad range of capabilities from the interactions among a small general set of mechanisms, holding out the possibility of combining deep science with highly practical outcomes. A grand unified architecture integrates across higher-level thought processes plus any other aspects critical for successful behavior in human-like environments, such as perception, motor control, and emotions.

Our focus at this point is on the development of the Sigma (Σ) architecture, which provides a hybrid (discrete+continuous) mixed (symbolic+probabilistic) approach, based on graphical models. To date with Sigma we have generated results across memory and learning, problem solving and decision making, mental imagery and perception, speech and natural language, emotion and attention, and multiagent systems and Theory of Mind.

Until now, ICT's integrated virtual human systems have been developed within version 7 of the Soar cognitive architecture. Soar has served the virtual human research efforts well, and the SASO system to this date remains one of the most sophisticated integrated virtual human systems worldwide. However, the underlying cognitive architecture is showing its age and despite its considerable strengths, it is becoming increasingly difficult to adapt the system to current-day needs.

The research and development of Sigma will allow us to leverage advances in research, knowledge and technology in order to create a novel cognitive architecture that is free of legacy drawbacks and ideally suited for the further advancement of virtual humans, to yield systems that are broadly, deeply and robustly cognitive, interactive with their physical and social worlds, and adaptive given their interactions and experience.

This effort, funded under ICT's basic UARC contract – along with funding from ONR (and past funding from AFOSR) – supports several TRADOC Warfighter Outcomes (WFO) directly and indirectly, in particular where training systems call for virtual characters. It may ultimately also support a wider variety of intelligent agents and robots.

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