Hide and Seek: Using Computational Cognitive Models to Develop and Test Autonomous Cognitive Agents for Complex and Dynamic Tasks

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Introduction

Computational cognitive modeling refers to the study of human cognition through the development of computer programs to simulate cognitive processes. It is rooted in Artificial Intelligence and Cognitive Psychology and is being used successfully in many basic and applied areas including user modeling in Human-Computer Interaction, student modeling in Intelligent Tutoring Systems, and agent modeling in Computer-Generated Forces.

In this abstract we describe the COGBOT project, an attempt to use computational cognitive modeling as a *cognition engine* to develop autonomous agents for complex and dynamic tasks.

The COGBOT Project

The COGBOT project started with the goal of producing *cognitively plausible* behavior rather than *computationally optimal* behavior. While computational optimal behavior is desirable for some AI problems, such as developing an efficient planning algorithm, it is inappropriate for others, such as developing agents for use as confederates and as opponents for computer-based training system.

With this goal in mind, we decided to use the ACT-R (Anderson & Lebiere, 1998) cognitive architecture as the cognition engine for the COGBOT project. ACT-R is a unified theory of cognition that has been fully implemented as a computer program. ACT-R has been used extensively to account for empirical data in Cognitive Science.

The Gamebots API (Adobbati, Marshall, Scholer, Tejada, Kaminka, Schaffer, & Sollitto, 2001) is an open-source software that allows people to receive percepts from and control actions of a bot (i.e. a software agent) in Unreal Tournament, a commercially available computer game. In the COGBOT project, we use Gamebots API to allow ACT-R to perceive and act in Unreal Tournament.

Hide and Seek

The first product of the COGBOT project is a pair of bots that plays a game of hide and seek. In this game, the Seek bot tells the Hide bot to go hide and counts 100 seconds. The Hide bot finds a good place to hide while the Seek bot is counting. After the 100 seconds are up, the Seek bot attempts to find the Hide bot within the allotted time (same as the count time).

Clearly, bots that play hide-and-seek can easily be implemented using any simple AI systems, so why use ACT-R? Consider the issue of memory. By default, bots in Unreal Tournament have a perfect memory of the map from the start. In the COGBOT project, we instead use ACT-R's declarative memory to represent the bot's map knowledge. In doing so, we inherit the properties of ACT-R memory system, such as recency and decay. That is, instead of implementing and validating our own theory of memory for the bots, we inherit the robust theory of memory in ACT-R, along with a theory of attention, learning, perception and action. By using ACT-R, we believe that we achieve a more faithful and more robust representation and production of *cognitively plausible* behavior from our bots.

Future Directions

The Hide and Seek bots are our proof of concept in integrating ACT-R theory and Gamebots API to examine coordinated action among multiple agents in complex and dynamic tasks. We have recently begun collecting data of people playing hide and seek in Unreal Tournament to provide us with a reference behavior (i.e. reality check) for our bots. We will continue to move forward by developing agents with (1) higher-level reasoning and decision-making abilities (e.g. tactics), (2) a more realistic representation of psychological time, and (3) ability to communicate and coordinate complex actions with other agents.

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