

Human-like Behavior, Alas, Demands Human-like Intellect

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Introduction

Over the years, filmmakers have perfected techniques for endowing animated characters with the illusion of life. Besides setting unrealistic expectations, however, this expertise offers little insight for creators of interactive media. Even a modest level of interactivity can easily shatter the illusion. Of course, given a narrow domain and extensive knowledge hacking, one can often engineer away some of these limitations (e.g., the participants of the Loebner Prize). What makes this workshop exciting is that researchers are beginning to put forth some structure to this engineering process and suggesting some more general techniques to aid in the construction of interactive realistic characters for less restrictive settings.

Like many involved in this workshop, I work under the assumption that the way to create more realistic expression of human behavior is to provide a more realistic model of cognition. So, while traditional interactive characters (particularly game agents) work under a simple situation-action model of behavior, my research has focused on creating internal state and processes that can mediate between situation and action. Arguably, this facilitates the creation of more coherent behavior, and allows for more subtle behavioral expression by using internal state (like emotion) to modulate behavioral manifestations, and by associating behaviors with internal processes (such as "thinking" gestures).

Modeling internal state and processes complicates the task of constructing interactive characters. To mitigate this additional overhead, I have developed a variety of domain-independent methods for representing and manipulating internal state information. Like some other approaches, such as Steve (Rickel and Johnson, 1997), I use artificial intelligence planning algorithms as the foundation of a richer model of cognition. However, plans are just one aspect of internal state. Emotion and personality clearly have a strong and noticeable impact on behavior. Even planful behavior is only partially captured by traditional planning methods, especially when one must support face-to-face social interactions between agents or people (c.f., Grosz and Kraus, 1996).

In addition to plans, my research has considered several other sources of internal state and processes that build on a basic planning foundation. These other sources include:

- 1) a domain-independent model of emotional state that treats emotions as a form of plan evaluation
- 2) a general approach to multi-agent reasoning that allows an agent to reason about the plans of other agents and guide its planning differently depending on its social relationship to those agents (collaborative, adversarial, independent), and
- 3) a way to model higher-level constructs such as obligations and intentions that constraint the way plans are generated and used (Bratman et al. 1988; Cohen and Levesque 1990; Pollack 1992; Grosz and Kraus 1996). These methods are described in two separate papers that will be presented at the autonomous agents conferences (Gratch, 2000; Hill, Gratch, and Rosenbloom, 2000);

These approaches share the characteristic that they act as a form of meta-reasoning, inferring properties of the current state of an agent's plans. Speaking broadly, my main effort has been to design a set of procedures that infer properties of the current plans in memory (e.g., this plan is relevant to that plan, this plan threatens that plan, this is how I "feel" about that plan...), a set of control constructs that alter the way plans are generated and executed (stop planning, start executing, plan collaboratively...), and a set of speech acts that operate over plans (is this plan acceptable? Would you inform me of your plans? Forget about that plan I just told you...). These then serve as the basic building blocks of a programming language (actually a meta-language) for guiding the way an agent interacts with its environment and other agents. (This may be seen as one proposal for implementing Grosz and Kraus' shared plans theory). In this language, one defines a set of meta-level actions that key off of changes in internal state variables (emotional state, current obligations, social role), and act by changing the setting of control constructions, or performing certain speech acts.

Returning to the question of behavioral expression, I argue that, beyond facilitating complex reasoning such as negotiation, this model of cognition provides a rich and hopefully coherent structure that supports a variety of behavioral manifestations.

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