Intelligent Agent Modeling as Serious Game

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Abstract

We propose a novel approach to intelligent tutoring gaming simulations designed for both educational and inquiry purposes in complex multi-actor systems such as infrastructures or markets. Rather than letting students perform guided role-play, the idea is to guide students as they construct, learn about and exchange delegate agents to test operations strategies in various simulated scenarios. While various technologies for end-user agent modeling and intelligent tutoring for ill-defined domains already exist, they are yet to be combined into a single intelligent simulation platform. We propose users construct the behaviors for their delegate agents at their own level of expertise. That is, simply selecting and adjusting some predefined agent behavior, shaping the desired behavior as it evolves in user-defined train scenarios, enacting example behavior for the agents to imitate, or building the behavior model in detail with simplified programming languages. The envisioned platform is a low-threshold interface for knowledge exchange and discovery where learning takes place between students, from agent to student and vice versa.

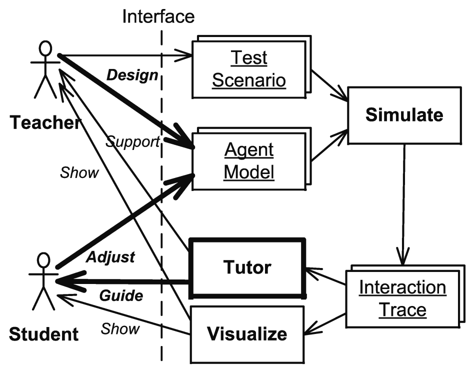
Why Students Should Model Agents

We are interested in combining intelligent tutoring and agent modeling in ill-defined domains such as operations management in infrastructures and marketplaces. We will extend an educational supply chain management game with various agent modeling techniques and intelligent tutoring to test whether students learn more operations management strategies from creating and comparing different sets of delegate agents, rather than by performing all operations personally. We believe that such intelligent programming microworlds hold great potential in complex, informal domains for educational, scientific and societal applications.

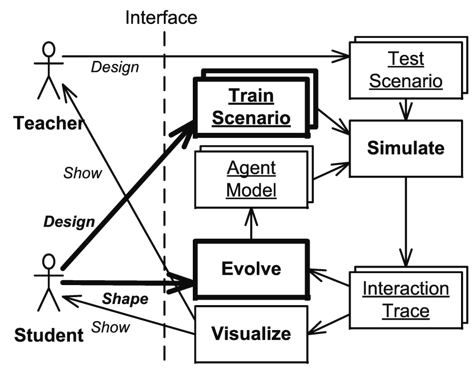
Educational settings. Users can design and exchange agents that are able to make many more decisions than the players could themselves. Since the game simply executes the user-defined agent models and does not need to wait for user input on each decision, the game environment complexity can increase much further as players gain experience using a technique called *dynamic difficulty adjustment* applied in games. Also, since the behavior is already formalized in a model, the game environment can evaluate the behavior much more effectively to determine whether learning goals are being achieved and provide suitable challenges or hints as is done in intelligent tutoring systems.

Scientific Settings. User-defined agent models provide much richer game data to study than a traditional action history does, since the reasoning behind the actions is also available. One could track changes in the models, so it may become easier observe whether and when learning occurs. With this formal structure, it becomes possible to use statistical methods to generalize behavioral patterns from the user-defined models stored from many sessions and apply these as human representative agents in other simulations.

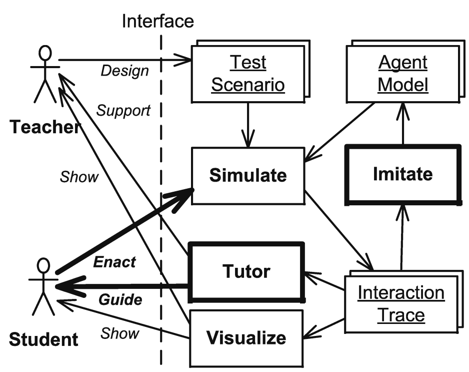
Societal Settings. An easy-to-use behavior modeling language might open up the realm of multi-agent simulation besides computer scientists and students to a large audience of lay users. Non-programmer employees of corporations and governments could still compare and experiment with new strategies in their particular domain, since the modeling language allows them to understand how the agents behave. Similarly, individual consumers would be able to define exactly how they would like their negotiator agent to represent them in for instance electronic markets or legal courts.



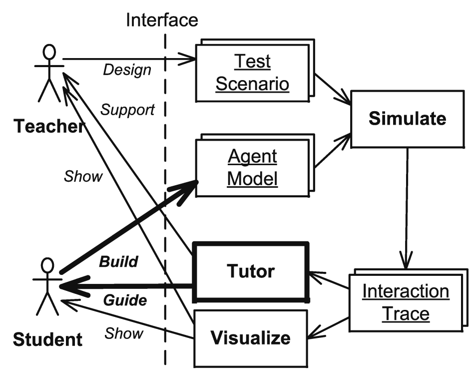
(a) Player adjusts selected behavior



(b) Player rewards behavior to evolve



(c) Player enacts behavior to imitate



(d) Player builds behavior

Figure 1: Serious game concept with four agent behavior modeling approaches.

We conceive our agent modeling game shown in Figure 1 to extend around a *simulator* which takes as input some *test scenario* and several *agent models*, one for each actor-agent in the scenario, to generate an *interaction trace* as output to visualize and provide remedial tutoring. A *teacher* designs the test scenario, while *students* adjust/shape/enact/build models for their actor-agents to succeed in this scenario.

The simplest way for a student to define a delegate agent is to *adjust* an agent model selected from an existing set (see Figure 1a). In the *shaping* mode (see Figure 1b), the objective is to train your agent by providing increasingly complex tasks that it must learn to solve autonomously using some genetic algorithm. Here the intelligent agents evolve to optimize a user-defined reward function, before being combined into a team containing various specialties that will compete with another team in some test scenario. With *imitation* (see Figure 1c) students must enact the desired behavior which the intelligent agents will try to duplicate and generalize into new situations, whereas finally *building* (see Figure 1d) is the most comprehensive thus suitable for more experienced students. Separately, these four methods have already been tried and tested with games and together might form a gradual learning path towards specifying and understanding various team behaviors. For a more detailed description of our proposal please refer to the full paper [1].

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References

[1] D. W. F. van Krevelen. Intelligent agent modeling as serious game. In F. Dignum, J. Bradshaw, B. Silverman, and W. van Doesburg, editors, *Post-Proc. of AGS'09: AAMAS 2009 Workshop on Agents for Games and Simulations*, Budapest, Hungary, 10 May 2009. Springer-Verlag. Forthcoming.