Intelligent Agent Modeling as Serious Game
Towards Integrating Microworlds, Tutoring and Evolution

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Abstract. Educators increasingly turn to serious games to let students
explore complex worlds in a safe environment. In serious games for ill-
defined problem domains such as infrastructures and markets, students
often interact with preconceived agents at an operational level. We hy-
pothesize however that students could discover more about a domain’s
complexity at a strategic level by building and testing their own delegate
agents. Testing this requires an environment where students and teachers
can construct agents at their own level of expertise with recent modeling
technologies. For instance, students may create agents not just directly,
by building or modifying comprehensive agent models with visual pro-
gramming languages, but also indirectly, by shaping agent behavior as
it evolves in user-defined training scenarios or by enacting example be-
behavior which agents learn to imitate. We propose a serious game concept
that combines such modeling methods within a single intelligent simula-
tion platform so that it becomes a low-threshold interface for continuous
knowledge exchange and gain between teachers, students and agents.

1 Introduction

After decades of educational games, today we are witnessing the third generation
educational use of computer games: serious games [1]. At the 2008 Game Develop-
ers Conference, serious game proponents Sawyer and Peters presented a compre-
hensive taxonomy that shows how serious games are increasingly being embraced
for diverse purposes, ranging from training, education and research to advertise-
ment, production and design [2]. The authors show that this trend appears not just
in public sectors like government and NGO’s, defense, health care and education,
but also private sectors for marketing & communications, corporate and industrial
applications. In fact, these collaborative human-in-the-loop simulation games, de-
signed either to educate players about particular phenomena or to study human
behavior within simulated environments, have become an important medium for
many applications and the body of related research is growing rapidly.

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We propose a new type of serious game in which users explore and delegate their strategies to adaptive agents with intelligent support at their own expertise level. Inspired by agent modeling games like StarLogo TNG\textsuperscript{1} and the Neuro-Evolving Robotic Operatives\textsuperscript{2} or NERO game \textsuperscript{3}, our interest is in combining various agent modeling methods with intelligent tutoring in ill-defined domains such as operations management in infrastructures and marketplaces. By extending the educational Global Supply Chain Game\textsuperscript{4} or GSCG \textsuperscript{5} with a range of intelligent agent and tutoring techniques, we may be able to determine how agent and tutoring technologies can enhance simulation games to help students learn more about strategy in ill-defined problem domains compared to manual operation. In this chapter we argue that the required technologies for intelligent agent modeling games exist, holding great potential for many educational, scientific and societal applications including ill-defined domains.

**Educational Settings.** Users can design and exchange agents able to make many more decisions than the players could themselves. Since the game simply executes the user-defined agent models it does not need to wait for user input on each decision, the game environment complexity can increase much further as players gain experience. 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 common in intelligent tutoring systems.

**Scientific Settings.** User-defined agent models provide much richer game data to study than traditional game action histories do, since agent models also provide the reasoning behind the actions. Instead, one may now much more easily track changes in the agent models and observe whether and when learning occurs. Moreover, the formalized models enable the use of statistical methods to generalize behavioral patterns from the user-defined models gathered over many sessions to serve as human representative agents in less expensive simulations that no longer require humans present.

**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.

To show how implementations of such agent modeling games might be achieved in ill-structured problem domains, we first review some of the existing theory related to intelligent agent modeling in serious games and simulations. We then describe the basic ideas and novelty of our game concept in more detail. Finally we conclude with a summary and discuss future work.

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\textsuperscript{1} http://education.mit.edu/starlogo-tng/
\textsuperscript{2} http://www.nerogame.org/
\textsuperscript{3} http://www.gscg.org/