Simulation of Skulduggery in a Multi-Agent System

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ABSTRACT

In a testing session, students may want to use the information of other students, which is cheating. The authors of this paper develop an artificial society to model and simulate this situation. They consider two control factors to increase the incentive of students to not cheat. The first factor is the penalty for similarity between responses (as much as two answer-sheets of two students are the same, their final grades decrease). The second factor is the observers who look into the students and do not allow the observed students to cheat. In this model, agents participate in a test based on their level of knowledge, location and two above factors, deciding whether or not to cheat. These components are used to formulate the utility function. Taking advantage of the developed artificial society, the authors now study the above factors affecting the amount of cheating in a test session.

Keywords: Artificial Society, Cheat, Multi-Agent System, Test Session, Utility Function

1. INTRODUCTION

Agent-based modeling is a new method of analyzing of dynamic complex systems. This is a new computational and analytical method envisaged as principal in many fields of study such as multi-level systems, since it gives a better understanding of micro levels and their emergent results at macro level. This method create a simplified representation of what occurs actually so that each agent plays the role of an individual person as if it is happening in environment reality (Gilbert, 2008). Various research for different purposes has been conducted in the field of simulating the behavior of students in an educational environment and how to communicate between people (Bing et al. 2010; Epstein & Axtell, 1996; Hofstede et al., 2009; Kim et al., 2011; Monica et al., 2008; Rao et al., 1991; Tisue et al., 2004).

In this study, we intend to simulate the relationship between individuals as a student in a test session. Behavior of the agent participant in the test, including all activities directly or indirectly involved in obtaining information for making appropriate decisions. Student behavior includes four important stages: information search, evaluation of alternatives,
decides whether or not to cheat and update. All intelligent agents, at any time, based on the information they receive from the environment, assess what the various options will be and then choose the best possible option. In fact, at this stage, the agent decides to answer the question of whether or not to cheat. Also, if the agent decides to cheat, then he (or she, but for simplicity we will use ‘he’) will select the best person for the job. Next, based on the decision, the agent updates the information.

Factors affecting the agent’s decision-making process are classified into two categories: Independent variables, which are related to the characteristics of each agent, such as, location and level of knowledge. And the control variables, which are controlled by the environment and are independent of the characteristics of each agent, such as, the relationship occurred between two agents, the amount of the penalty that has been considered and the observers who located in the test session.

In this model, the most important factor influencing the decision-making agent is the level of knowledge of each agent. We consider a number that representing a person’s ability to participate in the test as level of knowledge for each agent. The location of each agent is another important factor influencing the individual’s behavior. Using this parameter, we will examine the ability and the possibility of communication between intelligent agents. To describe and demonstrate how communication between intelligent agents is made, we will use Kleinberg graphical model (Kleinberg, 2000). We will determine the number of observers through the formulas in this model. Another important factor is the number of times that two intelligent agents interact with each other. The number of similarity between the responses has a huge impact on the decision-making agent, because at the end of the test, this factor will be evaluated. So, any time, the exchange of information between two agents takes place, the value of this factor will update. Another influential factor in this model is the inhibitory factor for cheating in a test. This factor is determined by the environment, the legal framework that applies to all agents, that represents the amount of the fine for observing the similar responses.

Given the importance of the implementation and having a good infrastructure for building and managing intelligent agents, in this paper we will use the MASQ meta-model that proposed by Ferber to develop a multi-agent system (Ferber & Stratulat, 2009). The MASQ meta-model provides a proper framework for multi-agent systems and it is based on the idea of four quadrant given by Wilber (2001). This model separates the individual from the shared and the physical from non-physical. This model includes the mind, body/object, space and culture. The MASQ meta model has been implemented in various areas of agent-based modeling and simulation (Osinga et al., 2010). The above briefly presents some of the main concepts in this paper and they will be treated in more detail later. We need all these elements to propose a conceptual and computational model for agent-based simulation of the student decision making processes.

The rest of the paper is organized as follow: Section 2 describes the student decision making process in detail. Section 3 studies the literature of agent-based simulation and agent architectures of student behavior and compares our model with other similar models. In Section 4, we propose our conceptual and computational model for student decision making processes. Section 5 includes the experimental results which confirm the validity of the proposed model. Finally in Section 6 we conclude the paper and suggest future work.

2. STUDENT DECISION MAKING PROCESS

The student decision making process involves four stages: Information search, evaluation of alternatives, decides whether or not to cheat and update. Figure 1 shows the student decision making process. The first stage in student decision making is information search. After facing each question, the agent will search for information. Information search consists of two
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