An educational game for learning Bayesian networks

There is currently a strong interest in using games for educational purposes, both in academia [1, 2, 3] and among the general public. In June 2013, 4000 K-12 students in Washington State engaged in an ”Algebra Challenge”, solving close to 400,000 equations by playing a game [4], and in July of the same year, the game-like language learning service Duolingo claimed to have more than five million active users [5].

Fields such as mathematics, in which it is possible to automatically check the correctness of the player's answers and thus provide constant feedback, are particularly well-suited for being taught via games. Games already implement many of the features which research on teaching has independently identified as contributing to good learning outcomes: for example, the Extreme Apprenticeship method stresses the values of learning by doing, continuous feedback, no compromise, and an apprentice becoming a master [6], all of which are present in many games.

Games also have potential in making previously uninteresting topics more compelling. Shaffer [2] notes that mathematics is hard to learn because the content matter is abstract and does not seem useful or meaningful for the student. Furthermore, inventing a ”real world” context for most problems actually makes the task of problem solving *harder*, as the learner needs to translate the verbal problem into a mathematical description before solving it in the normal way [7]. This adds extra work, but the problem usually still remains relatively uninteresting. To make the task itself meaningful, Shaffer [2] created *Escher's World,* a four-week game in which players became computer-aided designers working with various geometric shapes. After playing the game and experimenting with different geometric designs, the students' grades improved both in their mathematics and art classes, as the game had made the content of those classes meaningful in a new way.

For my Master's thesis, I seek to develop a game which provides a genuinely interesting and meaningful environment, while also teaching mathematics skills that can be used to navigate that environment. This requires identifying a domain which many people find meaningful, and which can be naturally analyzed using mathematical techniques.

A particular domain which humans find naturally compelling is that of social relationships and questions of trust and betrayal. One tool that has been frequently used for social network analysis is that of Bayesian networks. For example, probabilistic networks have been used as a tool for estimating the trustworthiness of different agents in a social network [8, 9], and He et al. [10] use a Bayesian network for inferring personal attributes and private information about different individuals on the LiveJournal blog service.

Many intuitive and socially relevant questions also have natural interpretations in terms of probabilistic nets: for example, ”Alice says that she heard from Bob that Carol's been having an affair, but Alice tends to always spin everything into a nasty rumor, so should I believe in her claim?” could be interpreted as a graph with information passing from Carol to Bob to Alice to the person asking the question, with some probability for the information being distorted on each step of the way. ”Should I believe in her claim?” would then correspond to estimating p(Carol is having an affair|Alice says that Carol is having an affair) based on knowledge about the structure of the network and the reliabilities of the individuals in question.

This suggests that a game of social drama could be a perfect candidate for teaching people to think in probabilistic terms, while also delivering a compelling and meaningful experience. The purpose of my thesis is to develop such a game, and explore the extent to which it is effective as a learning tool.

References

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