Researchers Advance Artificial Intelligence for Player Goal Prediction in Gaming

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For Immediate Release

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Researchers from North Carolina State University have developed artificial intelligence (AI) software that is significantly better than any previous technology at predicting what goal a player is trying to achieve in a video game. The advance holds promise for helping game developers design new ways of improving the gameplay experience for players.

"We developed this software for use in educational gaming, but it has applications for all video game developers," says Dr. James Lester, a professor of computer science at NC State and senior author of a paper on the work. "This is a key step in developing player-adaptive games that can respond to player actions to improve the gaming experience, either for entertainment or – in our case – for education."

The researchers used "deep learning" to develop the AI software. Deep learning describes a family of machine learning techniques that can extrapolate patterns from large collections of data and make predictions. Deep learning has been actively investigated in various research domains such as computer vision and natural language processing in both academia and industry.

In this case, the large collection of data is the sum total of actions that players have made in a game. The predictive AI software can then draw on all of that data to determine what an individual player is trying to accomplish, based on his or her actions at any given point in the game. And the software is capable of improving its accuracy over time, because the more data the AI program has, the more accurate it becomes.

"At some point that improvement will level off, but we haven't reached that point yet," Lester says.

To test the AI program, the researchers turned to an educational game called "Crystal Island," which they developed years earlier. While testing Crystal Island, the researchers amassed logs of player behavior (tracking every action a player took in the game) for 137 different players. The researchers were able to test the predictive AI software against the Crystal Island player logs to determine its accuracy in goal recognition. In other words, they could tell the AI everything a player had done in Crystal Island up to a certain point and see what goal the AI thought the player was trying to accomplish. By checking the AI's response against the player log, the researchers could tell whether the AI was correct.

"For games, the current state-of-the-art AI program for goal recognition has an accuracy rate of 48.4 percent," says Wookhee Min, a Ph.D. student at NC State and lead author of the paper. "The accuracy rate for our new program is 62.3 percent. That's a big jump."

The paper, "Deep Learning-Based Goal Recognition in Open-Ended Digital Games," will be presented at the Tenth Annual Conference on Artificial Intelligence and Interactive Digital Entertainment, being held Oct. 5-7 in Raleigh, North Carolina. The research was supported by the National Science Foundation under grants IIS-1138497 and IIS-1344803.

-shipman-

Note to Editors: The study abstract follows.

"Deep Learning-Based Goal Recognition in Open-Ended Digital Games"

Authors: Wookhee Min, Eun Young Ha, Jonathan Rowe, Bradford Mott, and James Lester, North Carolina State University

Presented: Oct. 5-7 at the Tenth Annual Conference on Artificial Intelligence and Interactive Digital Entertainment in Raleigh, North Carolina.

Abstract: While many open-ended digital games feature non-linear storylines and multiple solution paths, it is challenging for game developers to create effective game experiences in these settings due to the freedom given to the player. To address these challenges, goal recognition, a computational player-modeling task, has been investigated to enable digital games to dynamically predict players' goals. This paper presents a goal recognition framework based on stacked denoising autoencoders, a variant of deep learning. The learned goal recognition models, which are trained from a corpus of player interactions, not only offer improved performance, but also offer the substantial advantage of eliminating the need for labor-intensive feature engineering. An evaluation demonstrates that the deep learning-based goal recognition framework significantly outperforms the previous state-of-the-art goal recognition approach based on Markov logic networks.

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