Development of Lab Assistant: Use of Neural Networks in Video Games for Human-AI Partnership

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Abstract

One of the key benefits of a machine learning system is the fact that it can adapt, change, and learn with more experience. However, pre-trained algorithms forfeit this benefit, because continued play does not continue to impact the AI's performance. With Lab Assistant, the team had two goals: to include human-driven training as part of the game loop, and to create an emotional bond between the artificial intelligence and the player. The game can be accessed for free at the website: https://lizfiacco.itch.io/lab-assistant.

Explanation of Machine Learning Driven Gameplay in Lab Assistant

The gameplay of Lab Assistant is entirely reliant on machine learning technology. The game takes place in a laboratory, where the chemicals on the table need to be arranged to match a formula on a whiteboard. Only your lab assistant (an animated blob of slime) can manipulate the chemicals, so you must give it instructions via text input. The slime has no vocabulary or keywords at the start but picks up on your patterns using a dynamic neural network designed for natural language processing. The slime predicts likely strings of actions to perform that change specific values on specific beakers, and the player accepts or rejects these attempts as it tries them. After the formula is completed and the puzzle is won, the information that the slime learned is fed back into the neural net which improves its performance in the next round, eventually developing a unique pattern of communication between the player and the AI.

Developing Human-AI Partnership

This project presented several unexpected challenges as we worked to develop a strong sense of human-AI partnership.

Just as with state-script game AI, we wanted to hide the specific computational mechanisms at work so the player would regard it as a character. We used emotional cues, such as a pondering animation while the algorithm was loading, happy animations when it was rewarded, and irritated animations occasionally when it was corrected. These touches give the player the impression the slime is 'feeling' instead of calculating. This technique also meant the player was willing to forgive mistakes more readily, because there seems to be an expectation that a computer should get things right or it is 'broken'.

Next Steps for Machine Learning AI in Games

This project was a result of a very short development cycle, developed primarily as a proof-of-concept. We have yet to find the reasonable upper limits of real time neural network computation, or dive deeply into performance improvements. Continued development of this technology will be conducted on subsequent projects.

Technology Development for Lab Assistant.
We built out own learning software for Lab Assistant, based on the paper *Learning Language Games through Interaction*. At the time of development, Unity did not have any native machine learning integration. The drawback is that the custom-built technology means developing other machine learning titles would be just as arduous.

Expanding Neural Network Tools for Game Developers. Key members of the Lab Assistant team have since developed a plugin for Unity that enables integration of Dynet, simplifying the process of setting up and running a live neural net during a game session, with hopes that it can increase both the scale of the projects and the accessibility of machine learning to entertainment-focused developers.

Professional Experience

Liz Fiacco is an experienced game designer, with credits on Naughty Dog’s Uncharted 4, and Obsidian’s Stick of Truth and Pillars of Eternity. She is currently designing on an unannounced project, teaching level design at Gnomon, and spending time developing independent game projects.

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