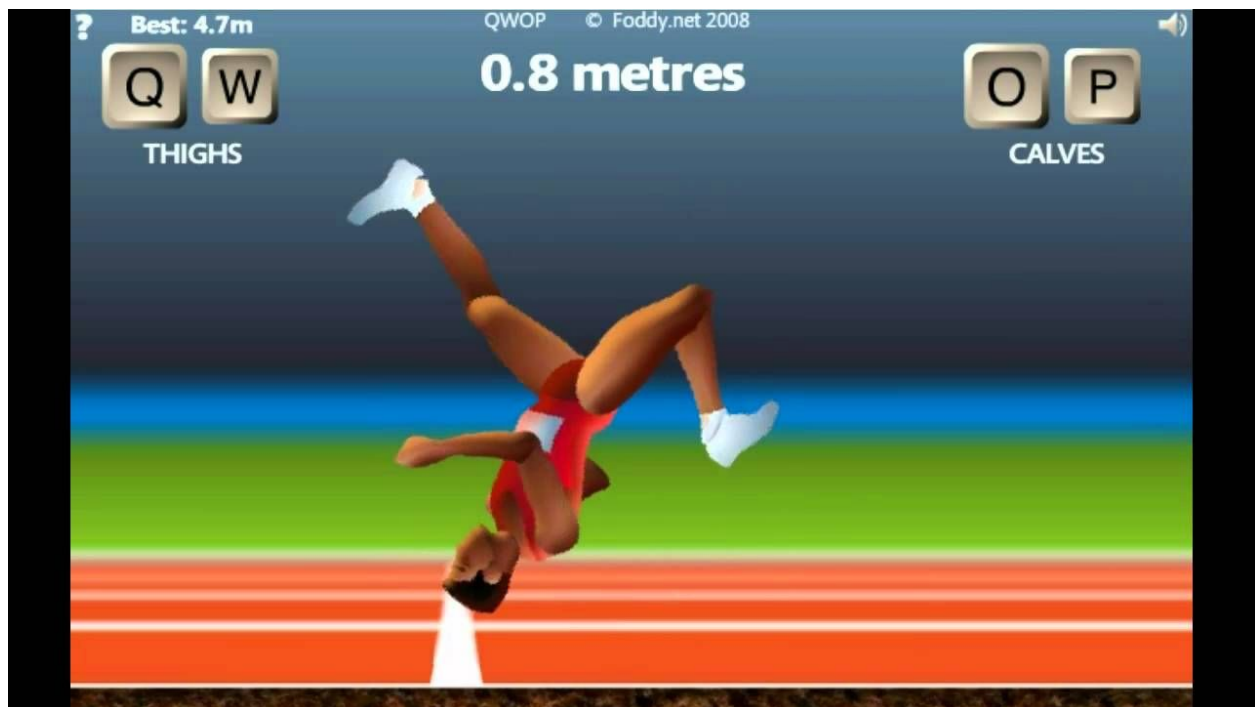# Project 4

QWOP AI

Retrospective Report

International Justice League of Super Acquaintances

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The QWOP AI bot learns how to play the flash game QWOP using a modified Q-Learning algorithm. It sends key press input through a Selenium web driver, parses the information from the game using screenshots, and then updates a matrix of control data with their learned beneficial value to be used in the next iteration.

What we promised VS What we delivered

Minimum Viable Product (MVP)
In our proposal, we outlined the following requirements for our MVP:

1. Learns how to play the QWOP video game.
2. Improves its performance (fitness) over time as it plays and receives feedback.
3. Provides persistent storage of learned information.
4. Capable of playback at different stages of learning.

All sections of the MVP were completed successfully.

What went well

Interesting Project Choice
We are very happy that we chose this project because it allowed us to continue to learn new concepts that we otherwise may never encounter during our academic career. The material we covered includes Webpage Automation, Image Parsing, and of course Machine Learning. Although there were many challenges, they helped us develop our coding and problem solving skills.

Areas we improved

Self-driven Development and Autonomy
We were able to quickly delegate tasks and work on our tasks without a large need for frequent meetings. This reduced stress and is indicative of our ability to work together as a team.

Things we couldn't control

Non-deterministic Game
Inputting the same controls at the same time during a run of the game will not result in the same outcome, which made the learning algorithm very hard to fine tune. We ended up having a very conservative learning algorithm that would base the perceived value of each decision on a predetermined pattern. Furthermore, even the digital readout of the distance would move in both position and shape based on the distance.

Difficulty Parsing Information From Game
The game is coded in flash, which essentially meant that the only way to get information out of it was by taking a screenshot and parsing the raw image data. For this project, we were only able to parse the distance data from the game, although we wanted to parse more

stateful data such as the torso angle, torso height from the ground, thigh angle, and ankle angle in order to get a better state from the game that could be used in the learning algorithm.

Lessons learned

Webpage Automation
There were challenges at all levels of this project. One challenge we had to overcome was the web automation framework we used was missing some critical functionality that was required, namely being able to hold down keyboard keys for a specified amount of time. This was overcome with the AWT library's Robot class. We also were required to use a suite of utilities developed prior to the start of the project by group member Stefan Kraus.

Artificial Intelligence Methods
For the final project, we used a slightly modified Q-Learning method alone to make decisions. This made a very inconsistent "Player" that was very likely to fail, either by not being able to move forward at all or by eventually getting into a state where the choice the algorithm chooses to be the most beneficial (or rather least detrimental) would be the "No-Input" option, which led to the bot getting stuck indefinitely. However, it was very helpful to learn about the Q-Learning method and the theory of reinforcement learning. It was poignant to see the parallels between how humans learn and the mathematical model for Q-Learning. We also researched Neural Networks, but the concept proved to be too complex and the resources available were insufficient for us to reasonably recreate this model.

Conclusion

Project "QWOP-AI" has been successful. Our group, The International Justice League of Super Acquaintances, was able to provide all of the functionality we promised in our proposal MVP. Especially considering the complexity of the project and the challenges we were able to overcome during development, we believe it is more than fair to request that the payment of an "A" grade be rendered to each member of the group; Brody Concannon, Nathan Karasch, Stefan Kraus, and Gregory Steenhagen. Additional payment can be negotiated in the case that the customer, Kent Vandervelden, finds the project to be exemplary.