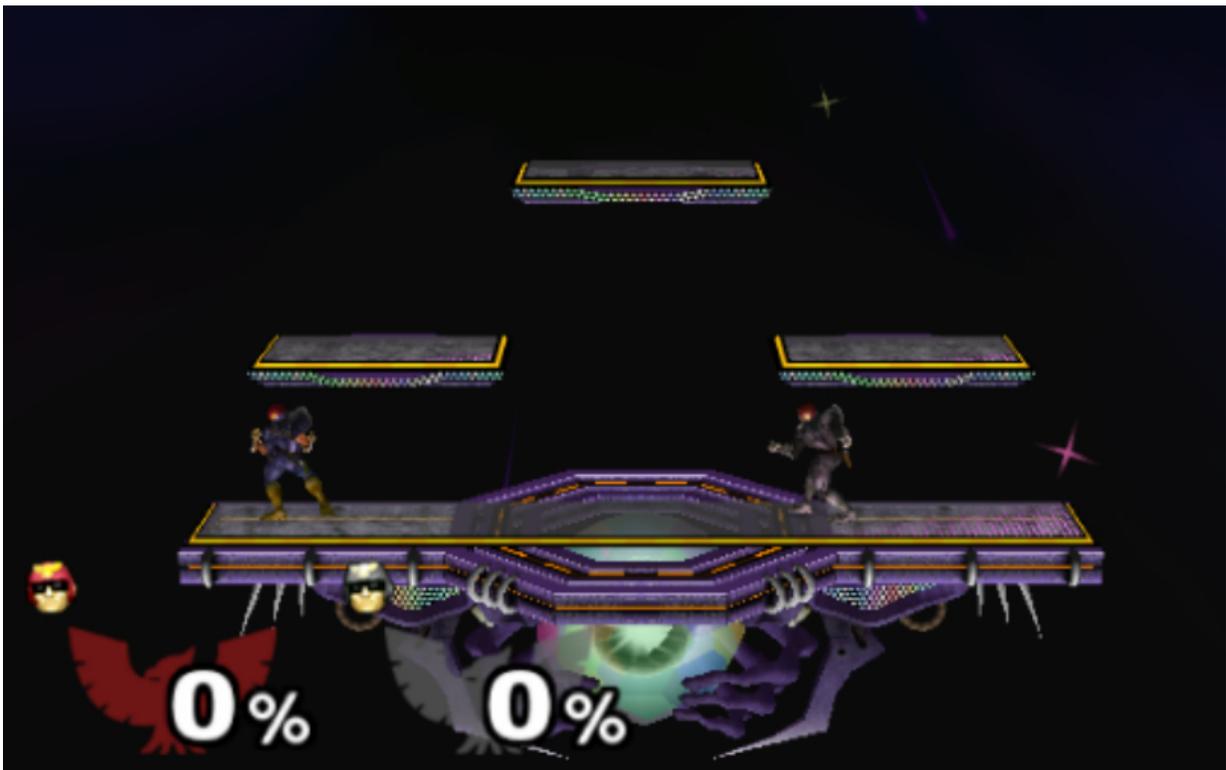


# Terribly terrific AI can brawl with the best players in fighting game

February 28 2017, by Nancy Owano

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(Tech Xplore)—Even top players of the video game Super Smash Bros. have to take a back seat to AI, according to latest reports.

A video is up of the popular Super Smash Bros. Melee battle (Super

Smash Bros. Melee (SSBM) is a console fighting [game](#)) and, ouch, the AI shows no mercy.

AI bragging rights in playing Nintendo's Super Smash Bros. game were supported by the fact that AI played the game using deep learning algorithms against ten highly-ranked players. The AI came out on top against every one of them, said *New Scientist*.

How they did it: Paul Lilly in *Hot Hardware* said they used [deep learning algorithms](#), honing the AI skills in Nintendo's "brawler."

Super Smash Bros. is a multiplayer game, and AI plays with a reaction speed worth noting. *Hot Hardware* said It has a [reaction](#) speed of around 33 milliseconds, versus around 200 milliseconds for humans. Lilly said the AI team was led by Vlad Firoiu.

Julian Togelius at the NYU Game Innovation Lab was quoted in *New Scientist* talking about the speed reaction. Computers excel at the fast reaction times that give players an advantage in this kind of game. "Compared to other games, fighting games rely very little on long-term planning and very much on quick reactions," he said. In turn, Togelius was not surprised that AI came out on top in the Super Smash Bros. Melee. In that kind of game, "computers excel at the fast reaction times that give players an advantage in this kind of game."

Dave Gershgorn in *Quartz* wrote about the AI: Firoiu "started making the bot play itself over and over again, slowly learning which techniques fail and which succeed, called reinforcement learning. Then, he left it [alone](#)."

One of the interesting features about this bot is that "Based on its past playing experiences, it learns that certain combinations of moves are more effective, through thousands of games of trial and error."

The code is at GitHub, where notes describe what Phillip, the AI, is all about. The notes define the [AI](#) as an SSBM player based on deep reinforcement learning.

The page read, "Tested on: Ubuntu >=14.04, OSX."

Training is controlled by `phillip/train.py`. The page said that Phillip has been trained at the MGHPCC. It is recommended to train with a custom dolphin from [github.com/vladfi1/dolphin](https://github.com/vladfi1/dolphin) -

What is the MGHPCC? The Massachusetts Green High Performance Computing Center has the infrastructure for computationally intensive [research](#). The MGHPCC site said, "Computers at the MGHPCC run millions of virtual experiments every month, supporting thousands of researchers in Massachusetts and around the world. It is open for use by any research organization."

So what do you have to do to get ahead in this game? It definitely brings out more than the wimp in you. You have to knock your enemy out of bounds. Doing so gets easier after doling physical damage, said Lilly, using different hits and special powers. Gershgorn said players try to gain advantageous ground while punishing their opponents, until they're weak enough to knock off the stage.

The authors wrote a paper about their work titled "Beating the World's Best at Super Smash Bros. with Deep Reinforcement Learning" and it is up on arXiv. It was submitted in February.

Authors are Vlad Firoiu, William Whitney and Joshua Tenenbaum.

They stated that they set out to show it was possible to train agents that are "competitive against and even surpass human professionals, a new result for the multi-player video game setting."

According to the abstract: "The SSBM environment has complex dynamics and partial observability, making it challenging for human and machine alike. The multi-player aspect poses an additional challenge, as the vast majority of recent advances in RL have focused on single-agent environments. Nonetheless, we will show that it is possible to train agents that are competitive against and even surpass human professionals, a new result for the multi-player video game [setting](#)."

*New Scientist* said the team is taking this further. They are thinking about "restricting the [AI's](#) reaction speed to see if they can build a system that is strategically superior when playing at human speed."

**More information:** Beating the World's Best at Super Smash Bros. with Deep Reinforcement Learning, arXiv:1702.06230 [cs.LG]  
[arxiv.org/abs/1702.06230](http://arxiv.org/abs/1702.06230)

## **Abstract**

There has been a recent explosion in the capabilities of game-playing artificial intelligence. Many classes of RL tasks, from Atari games to motor control to board games, are now solvable by fairly generic algorithms, based on deep learning, that learn to play from experience with minimal knowledge of the specific domain of interest. In this work, we will investigate the performance of these methods on Super Smash Bros. Melee (SSBM), a popular console fighting game. The SSBM environment has complex dynamics and partial observability, making it challenging for human and machine alike. The multi-player aspect poses an additional challenge, as the vast majority of recent advances in RL have focused on single-agent environments. Nonetheless, we will show that it is possible to train agents that are competitive against and even surpass human professionals, a new result for the multi-player video game setting.

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