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GOOGLE'S AI DECLARES GALACTIC WAR ON *STARCRAFT*

BLIZZARD

Tic-tac-toe, checkers, chess, Go, poker. Artificial intelligence rolled over each of these games like a relentless tide. Now Google's DeepMind is taking on the multiplayer space-war videogame *StarCraft II*. No one expects the robot to win anytime soon. But when it does, it will be a far greater achievement than DeepMind's conquest of Go—and not just because *StarCraft* is a professional e-sport watched by fans for millions of hours each month.

DeepMind and Blizzard Entertainment, the company behind *StarCraft*, just released the tools to let AI researchers create bots capable of competing in a galactic war against humans. The bots will see and do all all the things human players can do, and nothing more. They will not enjoy an unfair advantage.

StarCraft II games that will likely be vital to the development of these bots, and say the trove will grow by around half a million games each month. DeepMind applied machine-learning techniques to Go matchups to develop its champion-beating Go bot, AlphaGo. A new DeepMind paper includes early results from feeding *StarCraft* data to its learning software, and shows it is a long way from mastering the game. And Google is not the only big company getting more serious about *StarCraft*. Late Monday, Facebook released its own collection of data from 65,000 human-on-human games of the original StarCraft to help bot builders.

Such efforts could produce more than just fun. Google says it used machine learning from DeepMind to slash cooling bills in company datacenters. Mastering *StarCraft* could see software take on more complex and lucrative jobs. "From a scientific point of view, the properties of *StarCraft* are very much like the properties of real life," says David Churchill, a professor at Memorial University of Newfoundland who advised DeepMind on its StarCraft tools who has organized a leading StarCraft bot competition. "We're making a test bed for technologies we can use in the real world."

an unofficial, open-source plugin. Churchill says those bots so far are mediocre players that rely mostly on tactics coded by their designers, rather than machine learning, to build up their own grasp of the game.

Declaring war on *StarCraft* provides a measure of the ambition at Google and Facebook—and the limitations of today's smartest software. *StarCraft* is a real-time strategy game in which players command an alien army in a distant corner of the Milky Way. While the game may appear less daunting than Go or chess, it poses a greater challenge to AI.

In chess and Go, you can see all your opponent's moves and pieces, making them so-called perfect information games. *StarCraft* is an imperfect information game. You cannot see all of your opponents' troop deployments or construction projects, forcing you to use what you've seen, and your mental model of the game, to predict what they may be planning.

In addition, *StarCraft* bots won't be able to lean so heavily on their super-human ability to quickly crunch through myriad possibilities. The number of valid positions on a Go board is a 1 followed by 170 zeros. Researchers estimate

StarCraft's complexity. "It's a big step up," says Oriol Vinyals, a DeepMind researcher working on StarCraft. "This game will require us to innovate in planning, memory, and how we deal with uncertainty."

Beating *StarCraft* will require numerous breakthroughs. And simply pointing current machine-learning algorithms at the new tranches of past games to copy humans won't be enough. Computers will need to develop styles of play tuned to their own strengths, for example in multi-tasking, says Martin Rooijackers, creator of leading automated *StarCraft* player LetaBot. "The way that a bot plays *StarCraft* is different from how a human plays it," he says. After all, the Wright brothers didn't get machines to fly by copying birds.

Churchill guesses it will be five years before a *StarCraft* bot can beat a human. He also notes that many experts predicted a similar timeframe for Go—right before AlphaGo burst onto the scene.