

AI meets Angry Birds

Could this be the year that AI is going to surpass human performance in playing the popular video game Angry Birds? The organizers of the annual AIBIRDS competition discuss the challenges involved.

Angry Birds by Rovio Entertainment is one of the most popular video games of all time. It is also a simple and intuitive game that even small children can play well after some practice. However, so far no AI system has been developed that comes close to human performance.

The aim of the game is to destroy a bunch of green pigs by throwing birds at them with a slingshot. The pigs are protected by a physical structure made up of blocks with different sizes, shapes, colours and properties (pictured, top). Some birds have special powers that can be activated while the bird is in flight. The only actions available are to select a bird trajectory by pulling the bird back in the slingshot to the release coordinates (x, y) and then tapping the screen at time t after release to activate the bird's special power. Points are scored by destroying as many blocks as possible using as few birds as possible, but a score only counts when all pigs in a level are destroyed. The beauty of the game is that the internal physics engine calculates all behaviour in real-time and makes the physical interactions look real. Players don't have access to the internal physics engine and have to predict the outcome of a possible action from previous interactions.

There is a large number of possible actions (x, y, t) . For each one the exact outcome is essentially unknown so that it is very hard to plan ahead even two moves. In contrast, in games like chess or Go, the number of possible actions is relatively small and the outcome of every action is exactly determined, so planning ahead a large number of moves is possible.

The Angry Birds AI Competition (<https://aibirds.org>) encourages the AI community to develop agents that can deal with a large action space, that don't have complete knowledge about the physical parameters of objects and where, therefore, the consequences of possible actions can only be estimated. No forward model is available. Humans deal with such situations all the time and quickly build up experience to estimate outcomes within the physical world. Future AI needs to have the same capabilities: robots that



Top: a sample Angry Birds level. Green pigs have to be destroyed by shooting birds at them with a slingshot. Bottom: a level generated by the winner of the last Angry Birds Level Generation Competition. Credit: Rovio Entertainment

are not aware of the consequences of their physical actions will be unsafe in a human environment.

We have been organizing the AIBIRDS competition¹ annually since 2012, mostly collocated with the International Joint Conference on Artificial Intelligence. We run different elimination rounds where agents have 30 minutes to play eight new levels per round, until a winner is determined. After every competition we run a human versus machine challenge where members of the general public (mostly conference attendees) try to beat the four best AI agents. Over 60 teams have participated so far, and we have seen many different approaches, such as advanced simulation, reasoning, planning, heuristic search, various machine learning approaches (including deep learning), and combinations thereof. Apart from our first competition in 2012 where our sample agent won, all competitions have been won by agents that use heuristics to determine the next action.

Machine learning approaches have been largely unsuccessful. Despite all the successes of deep learning in the past few years, no deep learning based agent has yet entered the semi-final round of our competition. While the best agents play reasonably well, none of them comes close to good human players. The strategy most agents use is to simply find a good shot for the current bird. To encourage agents to plan ahead, we introduced what we call

deceptive levels², where the typical greedy strategies that agents use do not lead to good outcomes. For example, an action that only destroys very little has to be done first in order to finish a level with the next action. Humans can deal with such levels easily: they can detect the deception after their first attempt, restart and finish the level in their second attempt.

One problem machine learning faces is the limited number of Angry Birds levels for training. We are trying to address that by also organizing an Angry Birds Level Generation Competition³, where the task is to use procedural content generation to automatically create fun, creative and difficult Angry Birds levels (pictured, bottom). We have been running this competition annually since 2016 as part of the IEEE Conference on Computational Intelligence and Games (CIG), now called the IEEE Conference on Games (CoG).

In a recent survey of AI experts, Angry Birds was considered as a next milestone where AI will surpass humans⁴. More importantly, solving the Angry Birds Challenge could contribute to tackling one of the grand challenges of AI and robotics: safe and seamless interaction with the physical world. □

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Published online: 9 July 2019
<https://doi.org/10.1038/s42256-019-0072-x>

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Competing interests

The authors declare no competing interests.