Special Issue on AI in Games

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Dear reader,

We are happy to present you with a special issue of the KI journal on AI in Games. In the last decade, this field has developed from a niche for people believing in better AI players for Chess and Go into a very vibrant and broad research field that makes it into the news regularly. It is now connected to the recent successes of AI opponents beating the world best human Go or StarCraft players. Games have been setup as highly challenging but still accessible model systems where AI can learn how to take complex decisions.

In addition to AIs that play games, AI in games is becoming a large research field that includes areas as diverse as procedural content generation (PCG), computational narrative, AI-assisted game design, game analytics and many more. In the first technical contribution, we review the current state of AI in games, how game AI research is driving AI research, and how advances made in game AI are also starting to be employed in areas outside of games, such as robotics. We also highlight the many game AI competition environments, which have had a big impact in driving the progress in this field over the last couple of years.

The next two technical contributions deal with such competitions. In their article *The AI Settlement Generation Challenge in Minecraft*, Christoph Salge, Michael Cerny Green, Rodrigo Canaan, and Julian Togelius describe the first year of a Minecraft competition, in which the goal of the AIs is to generate interesting settlements. In the article *The Many AI Challenges of Hearthstone*, Amy Hoover, Julian Togelius, Scott Lee, and Fernando de Mesentier Silva discuss the

interesting and new AI challenge the collectible card game Hearthstone (Blizzard 2014) offers.

The paper *I Feel I Feel You: A Theory of Mind Experiment in Games* by David Melhart, Georgios N. Yannakakis, and Antonios Liapis looks at the theory of mind in human-agent interactions and is followed by the paper *Matrix- and Tensor Factorization for Game Content Recommendation* by Rafet Sifa, Raheel Yawar, Rajkumar Ramamurthy, Christian Bauckhage, and Kristian Kersting that deals with the challenge of recommending in-game content for the game *Trollhunters: Adventures in the Troll Caves* in order to increase player retention.

In addition to these technical contributions, two experts shared their opinions with us in interviews. We talked to Tom Schaul, a senior researcher at Google DeepMind about the details behind their recent AlphaStar algorithm, the first AI that was able to reach grandmaster level in StarCraft II. Duygu Cakmak, a senior AI programmer working at Creative Assembly, gives an industry perspective on recent game AI developments, collaborations with research labs at universities, and her work on the Total War video game series.

In addition to gaining more popularity from game companies, game AI research is also becoming more recognized by the broader scientific community and game AI projects are started to being supported by one of the most prestigious European grants awarded by the European Research Council (ERC). In his project report *AI for Ancient Games: Report on the Digital Ludeme Project*, Cameron Browne describes a 5-year ERC funded research project that uses AI techniques to increase our understanding of how early strategy games were played for which we only have incomplete descriptions.

For researchers interested in getting more involved in game AI and for those trying to gain a deep understanding of the subject, we refer the interested reader to the book *Artificial Intelligence and Games* by Georgios Yannakakis and Julian Togelius, which is reviewed in this special issue by Simon Lucas, a professor and director of the Game AI Research Group at Queen Mary University of London. The special issue is complemented by a report on one of its main conferences, the IEEE Conference on Computational

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Intelligence and Games (now renamed to the IEEE Conference on Games), by Mark H.M. Winands.

Finally, the special issue also includes abstracts of two recent doctoral dissertations. Vanessa Volz studies how algorithms can deal with uncertainties, which is a common challenge in many games and also has important implications for algorithms that have to deal with the uncertainties in the real world. Nicolas Arturo Barriga investigates how search algorithms that need to operate in games with large state and action spaces (e.g. such as in real-time strategy games; RTS), can do better by decomposing the larger problem of playing RTS games into multiple smaller sub-problems.

We want to thank all the people for their time and effort that made this special issue possible, especially the authors and all the reviewers.

Best wishes and we hope you enjoy reading this special issue,

Sebastian Risi and Mike Preuss

1 Content

1.1 Technical Contributions

- From Chess and Atari to StarCraft and Beyond: How Game AI is Driving the World of AI—Sebastian Risi and Mike Preuss
- The AI Settlement Generation Challenge in Minecraft—Christoph Salge, Michael Cerny Green, Rodrigo Canaan, and Julian Togelius
- The Many AI Challenges of Hearthstone—Amy Hoover, Julian Togelius, Scott Lee, Fernando de Mesentier Silva
- I Feel I Feel You: A Theory of Mind Experiment in Games—David Melhart, Georgios N. Yannakakis, Antonios Liapis
- Matrix- and Tensor Factorization for Game Content Recommendation—Rafet Sifa, Raheel Yawar, Rajkumar Ramamurthy, Christian Bauckhage, and Kristian Kersting

1.2 Interviews

- A Games Industry Perspective on Recent Game AI Developments—Interview with Duygu Cakmak, Creative Assembly

- Behind DeepMind’s AlphaStar AI that Reached Grandmaster Level in StarCraft II—Interview with Tom Schaul, Google DeepMind

1.3 Book Review

- Artificial Intelligence and Games—Simon Lucas

1.4 Project Reports

- AI for Ancient Games: Report on the Digital Ludeme Project—Cameron Browne

1.5 Conference Report

- 2018 IEEE Conference on Computational Intelligence and Games (CIG 2018)—Mark H.M. Winands

1.6 Doctoral Dissertations

- Uncertainty handling in surrogate assisted optimisation of games—Vanessa Volz
- Search, Abstractions and Learning in Real-Time Strategy Games—Nicolas Arturo Barriga

2 Service

2.1 Conferences and Workshops

- Foundations of Digital Games (FDG)
- Conference on Games (CoG), until 2018 the Conference on Computational Intelligence and Games (CIG)
- Artificial Intelligence for Interactive Digital Entertainment (AIIDE)

2.2 Journals

- IEEE Transactions on Games (ToG)—formerly IEEE Transactions on Computational Intelligence and AI in Games (T-CIAIG)
- IEEE Transactions on Affective Computing