

# Reports of the Workshops Held at the Tenth AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment (AIIDE)

*Tiffany Barnes, Oliver Bown, Michael Buro, Michael Cook, Arne Eigenfeldt, Héctor Muñoz-Avila, Santiago Ontañón, Philippe Pasquier, Noriko Tomuro, R. Michael Young, Alexander Zook*

■ *The AIIDE-14 Workshop program was held Friday and Saturday, October 3–4, 2014, at North Carolina State University in Raleigh, North Carolina. The workshop program included five workshops covering a wide range of topics. The titles of the workshops held Friday were Artificial Intelligence for Adversarial Real-Time Games and Games and Natural Language Processing. The titles of the workshops held Saturday were Diversity in Games Research, Experimental AI in Games, and Musical Metacreation. This article presents short summaries of those events.*

## Artificial Intelligence for Adversarial Real-Time Games

Real-time strategy (RTS) games are complex real-time war simulations in which players have to manage economies, build structures and armies, and try to win by destroying all opponents' buildings. RTS games are interesting from an AI point of view because their decision complexity, generated by vast maps, large unit numbers, concurrent durative actions, and limited state observability, precludes solutions based on brute-force search and forces us to consider problem decompositions and abstractions. This workshop's goal was to bring researchers together who are interested in pushing the state of the art of RTS game AI systems and to discuss current and future research directions that can get us closer to constructing programs able to defeat the best human RTS game players.

In the AIIDE main conference three years ago several papers on the subject were presented. In addition, a panel discussion on RTS game AI took place, the StarCraft competition was discussed, prizes were awarded, and two exhibition match replays were shown. For some conference attendees

this was a bit too much RTS game content. For others, it wasn't enough because little was said about the inner workings of the strongest competition entries. To address these concerns, the first workshop on RTS game AI topics was organized at AIIDE 2012, attracted 20 attendees, and featured nine paper presentations and a discussion that led to fruitful collaboration. In this year's sequel, three papers, two invited talks, and this year's AIIDE StarCraft AI competition report were presented to 14 attendees, who at the end were split into two discussion groups.

This year's papers focused on building placement optimization for RTS games, learning sequential patterns from game replays, and high-level game-tree search. Building placement optimization is concerned with slowing down opponents' attacks on bases as much as possible by erecting walls and closing gaps between structures, which increases the time attackers are exposed to defensive fire. Extracting playing policies from human game data is an active research topic, which when combined with high-level or hierarchical search has the potential to overcome human supremacy in the RTS game genre.

In the first invited talk, Graham Erickson, a recent M.Sc. graduate from the University of Alberta, presented his thesis work on state evaluation and opponent modeling in RTS games based on StarCraft replay data and combat simulations. The second talk by associate professor Florian Richoux from Université de Nantes introduced a fast general-purpose constraint solver that was applied to several RTS game AI problems, such as wall formation and target selection.

After the invited talks, Ph.D. student David Churchill (University of Alberta) presented this year's AIIDE StarCraft AI competition results, game analyses, and man versus machine match videos, which made it clear that today's best RTS game programs are still no match for strong human players.

The last 90 minutes of the workshop were spent on discussing what to discuss in the subsequent work-group session, for which the attendees split up in two halves: one group discussed past and future research directions, and the other which benchmark problem sets to add to future RTS game competitions.

Presentation slides and work-group results are available at [www.cs.ualberta.ca/~mburo/aiide14ws](http://www.cs.ualberta.ca/~mburo/aiide14ws). This workshop's papers are published as AAAI Press Technical Report WS-14-15. The [starcraftai.competition.com](http://starcraftai.competition.com) site hosts the discussed AIIDE StarCraft AI competition results, software, and game videos.

## The First Diversity in Games Research Workshop

Over the past 10 years, the area of computer games has expanded to be a significant area of computer science research, with a number of strong annual con-

ferences, *IEEE Transactions*-level journals, and a growing number of tenured faculty across the United States. Students at the undergraduate level are drawn in large numbers to pursue computer science degrees with concentrations or focus on game-creation methods, and federal funders are supporting exciting new computational developments relating to games. Nevertheless, the number of faculty from underrepresented groups in this area is significantly low. The workshop's aim is to encourage undergraduate and graduate students from underrepresented groups to engage in graduate training in games research and to better prepare them for entry into an academic research career in this field.

The workshop brought together more than 22 people. Roughly half participated as mentees including assistant professors, researchers (such as postdoctoral), students (Ph.D., M.S., and undergraduate), whereas the other half participated as mentors. The latter group consisted of members of the AIIDE community.

The format of the workshop encouraged discussion and participation by the workshop attendees. The workshop opened with a brief introduction by Tiffany Barnes (North Carolina State) and a presentation by Susan Rodger (Duke University) on career paths. This introduction was followed by a discussion about building a research representation, and how to present elevator versions of research. Participants then gave 3-minute elevator pitches on their vibrant directions in game research. Interactive narratives in virtual environments were a common theme among most presentations, a reflection of the growing attention on this research topic. Other topics presented included research topics related to massive online multiplayer games and educational games and a study relating digital animation, race, and gender. The 3-minute talks gave a first opportunity for mentors and mentees to interact in a focused setting. The poster session was followed by a lunch. Like all activities in the workshop, this lunch encouraged interaction among mentors and mentees. Lunch was followed by an open discussion with mentor Mark Reidl (Georgia Tech) on a variety of topics including funding sources for graduate school, job search and how to do effective job-interview presentations, and mentoring for diversity. After this discussion, participants resumed presenting 3-minute talks until all presented. The workshop concluded with a discussion on diversity in games and games research. The workshop activities continued during the main conference in the form of short individual mentor-mentee meetings and a lunch discussion on games and diversity that focused primarily on work-life balance.

No technical report was issued for this meeting. Tiffany Barnes, R. Michael Young, and Héctor Muñoz-Avila served as workshop co-chairs and wrote this report.

## Games and Natural Language Processing

Natural language processing (NLP) investigates computational aspects of natural language, languages that humans use to communicate and understand. While the field of NLP ranges from theoretical studies (such as parsing algorithms, computational models of dialogue) to practical applications (such as information retrieval, conversational agents, machine translation), this workshop focuses on NLP in games. In particular, the workshop, which began in 2012, aims at providing a forum for researchers and practitioners who are working in the overlapping area between the two fields to present their work and discuss the possibilities of promoting the interaction.

The workshop was well attended. In addition to the presenters, the participants included quite a few people from the main AIIDE conference attendees and local students who were interested in the workshop topic. The workshop began with a keynote speech by James Lester from North Carolina State, and for each paper and demonstration, there was a lively discussion by the participants. The workshop ended with an open discussion session in which the participants discussed the possibility of incorporating more (rich) natural language processing in games and what is needed or helpful in pursuing that goal.

The workshop brought together people with diverse interest in the overlapping area of the two fields. For example, some natural language-processing researchers were conducting research on dialogues and narratives in games (and characters), but had little experience in developing actual games. In contrast, some game developers and researchers were incorporating a speech or language component in the game, but had little idea how to make the component more sophisticated. The postworkshop feedback was quite positive: "The audience revealed they were mixed with respect to their area of focus: primarily games or natural language processing. Regardless, both areas were very respectful and interested in hearing about the other area."

Noriko Tonuro wrote this report. The workshop was organized by Noriko Tomuro, Kristy Boyer, and Yun-Gyung Cheong. The papers of the workshop were published as AAAI Press Technical Report WS-14-01.

### Experimental AI in Games

The Experimental AI in Games workshop fosters innovation in how AI is used in and for games. Research in game AI has traditionally focused on intelligent adversarial agent behavior, exemplified by chess-playing agents like Deep Blue. Yet games as entertainment experiences involve far more than expert-level opponent play. Game design and development include a plethora of challenges in producing content and reasoning on how game play creates

player experiences. AI techniques can help address these challenges. Further, many AI areas — including computer vision, natural language processing, user modeling, and computational creativity — have the potential to unlock new possibilities for game-play experiences. This workshop has two goals: encouraging long-term, blue sky thinking around new ways AI could be used in games and providing a venue for experiments on innovative uses of AI in games.

The workshop submissions this year clustered around three themes: new game mechanics possible through AI, ways to acquire game design knowledge, and new roles for AI in game creation. Game mechanics are rules that govern the flow of game states. Could AI systems enable games using mechanics that were previously impossible? Justus Robertson (North Carolina State University) demonstrated how planning techniques can be used to enable online alterations of a game world in an interactive narrative to guide players along an intended story in a game world. Ian Horswill (Northwestern University) showed how classical AI research in question answering and problem solving could yield innovative game mechanics based on mind control with natural language input. Participants discussed the challenges in creating AI-based game mechanics and potential avenues for AI-based games.

Procedural content generation systems create game content algorithmically. Most systems, however, are concerned with creating game assets and lack the semantic knowledge necessary to assemble content that is meaningful and sensible to humans. Michael Cook (Goldsmiths College, University of London) presented two approaches to mining existing knowledge bases for information relevant to games. "Google milking" harvests answers from feeding incomplete questions into a search engine. These results provide knowledge for game content including actions for in-game entities and relationships between entities to suggest in-game enemies or collectible content. Alternatively, chaining relations among concepts in ConceptNet can be used to find inspirational relationships for fictional game premises. Mark Riedl (Georgia Institute of Technology) presented the notion of playing games to make games as a way to gather game-relevant knowledge. This approach supported the automated generation of scenes in three-dimensional games from text-based descriptions by using a game to collect relevant spatial relationship data. Discussions concerned the challenges of gathering knowledge: ensuring knowledge is relevant, handling potentially offensive or inappropriate information, and motivating contributors to knowledge corpora.

Game creation is challenging. Designers make game content to indirectly create player experiences. How can AI systems enhance the game-creation process? Gillian Smith (Northeastern University) presented several future roles for procedural content generation in

games, including the notion of generating content that entertains a community of viewers. Kazjon Grace (University of North Carolina at Charlotte) took the notion of AI interfacing with game communities further by discussing the potential for computational creativity techniques to support game modding communities by working with the growing wealth of online game content resources. Jonathan Tremblay (McGill University) addressed design support by comparing how different search algorithms automatically solve game levels as a source of feedback to level designers. These papers stimulated discussion around how AI can improve the experience of game viewers and support game creators.

The workshop also included a panel discussion from the Research in Cognitive-Based Approaches to Intelligent Interactive Digital Entertainment workshop. Participants discussed the potential for new cognitive interfaces to provide alternative input to games and the possible uses of games for investigating human (and dog) cognition. The workshop concluded with a demonstration session where Justus Robertson showed his system guiding players along a story in both a text-based game and a two-dimensional adventure game. Tommy Thompson (University of Derby) also demonstrated an approach to automated pathfinding to enable new forms of interaction in touch-based games and analysis of player facility with different control methods.

This workshop was chaired by and this report was written by Alexander Zook and Michael Cook. The papers of the workshop were published as AAAI Press Technical Report WS-14-16.

## Musical Metacreation

Musical metacreation is the field concerned with automating musical production processes. Building on the success of the two previous workshops, the Third International Workshop on Musical Metacreation at AIIDE-14 was a one-day event that marked a significant step toward the consolidation of this international community that lies at the intersection of computer music, music theory, artificial intelligence, human-computer interaction, and multimedia.

While addressing the fundamental problems of providing computational models for music perception, representation, and cognition, the workshop aims to focus on the challenges specific to generative music systems. In particular, the composition problem is to generate a composition (often represented as a score), while the interpretation problem is to generate an audio rendering of a given composition. Systems that address these two canonic problems or any related ones cover the whole spectrum between symbolic computing versus raw audio signal processing, corpus-based systems that have been exposed to musical compositions or interpretations versus sys-

tems that generate from first principles, computational heuristics, or expert/artistic knowledge, individual versus collective musical creativity, and entirely generative systems versus interactive systems for computer-assisted musical creativity.

This workshop included 10 contributions selected through peer reviewing out of 16 submissions. Technical papers, position papers, and demonstrations were evenly spread across theory and practice. Topics included deep learning and neural networks for music, automatic sound design, generation of large-scale musical forms, generative articulation and dynamics, as well as cognitive musical agent architecture. As a novelty in this edition, a panel on how best to integrate the artistic and scientific impetus that motivates these systems concluded the day.

As the field matures, more and more generative music systems get applied and meet their audience. This is for example the case with the musical metacreation concert series, the Algorave movement, or the ChordPunch label releases. One of the recurring reflections pursued in this workshop is to consider the best ways to present and frame these systems when they meet their audience, whether it is in live shows, on records, or as part of software systems.

This report was written by Philippe Pasquier. The workshop was cochaired by Philippe Pasquier, Arne Eigenfeldt, and Oliver Bown and the papers of the workshop were published as AAAI Press Technical Report WS-14-01.

**Tiffany Barnes** is an associate professor of computer science at North Carolina State University in Raleigh, NC.

**Oliver Bown** is affiliated with the Design Lab, University of Sydney, Australia.

**Michael Buro** is a professor in the Computing Science Department at the University of Alberta in Edmonton, Canada.

**Michael Cook** is a research associate and Ph.D. student in the Department of Computing at Goldsmiths College, University of London.

**Arne Eigenfeldt** is a professor in the School of Contemporary Arts, Simon Fraser University, Canada.

**Héctor Muñoz-Avila** is an associate professor of computer science and engineering at Lehigh University in Bethlehem, PA.

**Santiago Ontañón** is an assistant professor in the Department of Computer Science at Drexel University in Philadelphia, PA.

**Philippe Pasquier** is an associate professor in the School of Interactive Arts and Technology, Simon Fraser University, Canada.

**Noriko Tomuro** is an associate professor at DePaul University.

**R. Michael Young** is a professor of computer science at North Carolina State University in Raleigh, NC.

**Alexander Zook** is a Ph.D. candidate in the School of Interactive Computing at the Georgia Institute of Technology.