PREFACE

These proceedings contain the papers of the Computer Games Workshop at IJCAI 2013 (CGW 2013) held in Beijing, China. The workshop took place August 3, 2013, in conjunction with the 23rd International Conference on Artificial Intelligence (IJCAI 2013). The Program Committee received 15 submissions. Each paper was sent to two referees. In the end, ten papers were accepted for presentation at the workshop, of which nine made it into these proceedings.

The published papers cover a wide range of topics related to computer games. They discuss six games that are played by humans in practice: Chess, Domineering, Chinese Checkers, Go, Goofspiel, and Tzaar. Moreover, there is one puzzle, the Sliding Tile Puzzle, one application, Cooperative Path-Finding problems, and one paper on General Game Playing. Below we provide a brief outline of the contributions, in the order in which they appear in the book.

"Monte-Carlo Fork Search for Cooperative Path-Finding" is authored by Bruno Bouzy. He proposes a new algorithm, called Monte-Carlo Fork Search (MCFS), which solves Cooperative Path-Finding (CPF) problems with simultaneity. Its background is Monte-Carlo Tree Search (MCTS) and Nested Monte-Carlo Search (NMCS). The key idea of MCFS is to build a search tree balanced over the whole game tree. After a simulation, MCFS stores the whole sequence of actions in the tree, which enables MCFS to fork new sequences at any depth in the built tree. The algorithm is suited for CPF problems in which the branching factor is too large for MCTS or A*, and in which congestion may arise at any distance from the initial state. With sufficient time and memory, Nested MCFS (NMCFS) solves congestion problems in the literature finding better solutions than the state-of-the-art solutions. It also solves N-puzzles without hole near-optimally.

"Building Large Compressed PDBs for the Sliding Tile Puzzle," written by Robert Döbbelin, Thorsten Schütt, and Alexander Reinefeld, describes the computation of 9-9-6, 9-8-7, and 8-8-8 Pattern Databases (PDB) for the 24-puzzle that are three orders of magnitude larger (up to 1.4 TB) than the 6-6-6-6 PDB. This is possible by performing a parallel breadth-first search in the compressed pattern space. Their experiments indicate an average eightfold improvement of the 9-9-6 PDB over the 6-6-6-6 PDB for the 24-puzzle.

"Monte Carlo Tree Search in Simultaneous Move Games with Applications to Goofspiel" is a joint effort by Marc Lanctot, Viliam Lisý, and Mark Winands, and discusses the adaptation of MCTS to simultaneous move games with and without chance events. They introduced a new algorithm, Online Outcome Sampling (OOS), which approaches a Nash equilibrium strategy over time. The authors compare both head-to-head performance and exploitability of several MCTS variants in Goofspiel. The result reveals that regret matching and OOS performs best and that all variants produced less exploitable strategies than UCT.

"Decision Trees for Computer Go Features," by Francois van Niekerk and Steve Kroon, investigates the feasibility of using decision trees to generate features for guiding MCTS in Computer Go. Their approach employs queries that refine knowledge of the current board position as the tree is descended. The experiments show that while this approach exhibits potential, the initial prototype is not as powerful as using traditional pattern features.

"UCT Enhancements in Chinese Checkers Using an Endgame Database" is a contribution of Max Roschke and Nathan Sturtevant. They assessed the performance of MCTS-based AIs and the effectiveness of augmenting them with a lookup table containing evaluations of games states in the game of Chinese Checkers. The lookup table is only guaranteed to be correct during the endgame, but serves as an accurate heuristic throughout the game. Experiments show that using the lookup table only for its endgames is harmful, while using it for its heuristic values improves the quality of play. The research is performed on a board with 81 locations and 6 pieces, which is larger than previous work on lookup tables in Chinese Checkers. It is a precursor to using the 500-GB full-game single-agent data on the full-size board with 81 locations and 10 pieces.

"Automated Generation of New Concepts from General Game Playing," by Yuichiro Sato and Tristan Cazenave, describes how to extract explicit concepts from heuristic functions obtained using a simulation-based approach. The proposed algorithm quickly learns new concepts without any supervision but from experience in the environment. Concepts to understand the semantics of Tic-tac-toe are generated by their approach. These concepts are also available to understand the semantics of Connect Four. The authors conclude that their approach is applicable to General Game Playing and is able to extract explicit concepts, which are able to be understood by humans.

“WALTZ: A Strong Tzaar-Playing Program,” written by Tomáš Valla and Pavel Veselý, introduces the game of Tzaar, part of the Project GIPF, to the AI community. It is an abstract strategy two-player game, which has recently gained popularity in the gaming community and has won several awards. The high branching factor makes Tzaar a difficult game for computers. The authors present WALTZ, a strong Tzaar-playing program, using enhanced variants of αβ and proof-number search. After many tests with computer opponents and a year of deployment on a popular board-gaming portal, the authors conclude that WALTZ can defeat all available computer programs and even strong human players.

“Perfectly Solving Domineering Boards,” by Jos Uiterwijk, presents the author’s research in the game of Domineering. For this game the author defined 12 knowledge rules, of increasing complexity. Of these rules, six can be used to show that the starting player (assumed to be Vertical) can win a game against any opposition, while six can be used to prove a definite loss (a win for the second player, Horizontal). Applying this knowledge-based method to all 81 rectangular boards up to 10×10 (omitting the trivial $1 \times n$ and $m \times 1$ boards), 67 could be solved perfectly. This is in sharp contrast with previous publications reporting the solution of Domineering boards, where only a few tiny boards were solved perfectly, the remainder requiring up to large amounts of search. Applying this method to larger boards with one or both sizes up to 30 solves 216 more boards, mainly with one dimension odd. All results fully agree with previously reported game-theoretic values.

“How Relevant Are Chess Composition Conventions?” is a contribution by Azlan Iqbal. Using an existing experimentally validated computational aesthetics model for three-move mate problems, the author analyzes sets of computer-generated chess compositions adhering to at least two, three, and four comparable conventions to test whether simply conforming to more conventions has a positive effect on their aesthetics, as is generally believed by human composers. The paper also analyzes human judge scores of 145 three-move mate problems composed by humans to see if they have any positive correlation with the computational aesthetic scores of those problems. The results suggest two main things. First, the right amount of adherence to composition conventions in a composition has a positive effect on its perceived aesthetics. Second, human judges either do not look at the same conventions related to aesthetics in the model used or emphasize others that have less to do with beauty as perceived by the majority of players, even though they may mistakenly consider their judgments “beautiful” in the traditional, non-esoteric sense.

This book would not have been produced without the help of many persons. In particular, we would like to mention the authors and referees for their help. Moreover, the organizers of IJCAI 2013 contributed substantially by bringing the researchers together.

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