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Preface

This book contains the papers of the *6th* Computers and Games Conference (CG 2008) held in Beijing, China. The conference took place from September 29 to October 1, 2008 in conjunction with the 13th International Computer Games Championship and the 16th World Computer Chess Championship.

The Computers and Games conference series is a major international forum for researchers and developers interested in all aspects of artificial intelligence and computer game playing. The Beijing conference was definitively characterized by fresh ideas for a large variety of games. Earlier conferences took place in Tsukuba, Japan (1998), Hamamatsu, Japan (2000), Edmonton, Canada, (2002), Ramat-Gan, Israel (2004), and Turin, Italy (2006).

The Programme Committee (PC) received 40 submissions. Each paper was initially sent to at least two referees. If conflicting views on a paper were reported, it was sent to an additional referee. Out of the 40 submissions, one was withdrawn before the final decisions were made. With the help of many referees (listed after the preface), the PC accepted 24 papers for presentation at the conference and publication in these proceedings.

The above-mentioned set of 24 papers covers a wide range of computer games. Twelve of the games are played in practice by human players, viz., Go, Western Chess, Chinese Chess (Xiangqi), Japanese Chess (Shogi), Amazons, Chinese Checkers, Hearts, Hex, Lines of Action, Othello, Siguó, and Spades. Moreover, there was one puzzle, viz., SameGame, and two theoretical games, viz., Synchronized Domineering and multi-player Can't Stop.

The papers deal with many different research topics including cognition, combinatorial game theory, search, knowledge representation, and optimization.

We hope that the readers will enjoy the research efforts of the authors. Below we provide a brief outline of the 24 contributions, in the order in which they are printed in the book.

“Single-Player Monte-Carlo Tree Search,” by Maarten Schadd, Mark Winands, Jaap van den Herik, Guillaume Chaslot, and Jos Uiterwijk, proposes a new Monte-Carlo Tree Search variant, called Single-Player Monte-Carlo Tree Search (SP-MCTS). The method is tested on the puzzle SameGame. It gained the highest score so far on the standardized test set of 20 positions.

“Amazons Discover Monte Carlo” is authored by Richard Lorentz. He incorporated the basic ideas of MC/UCT into the Amazons program INVADERMC and then made improvements to create a hybrid MC/UCT program. This hybrid version is considerably stronger than minimax-based INVADER.

“Monte-Carlo Tree Search Solver,” by Mark Winands, Yngvi Björnsson, and Jahn-Takeshi Saito, investigates the application of MCTS for the game Lines of Action (LOA). A new MCTS variant, called MCTS-Solver, has been designed to improve playing narrow tactical lines in sudden-death games such as LOA.

“An Analysis of UCT in Multi-player Games” is written by Nathan Sturtevant. It provides an analysis of the UCT algorithm in multi-player games, showing that UCT is computing a mixed-strategy equilibrium, as opposed to Max^n , which computes a pure-strategy equilibrium. The author shows that UCT performs as well or better than existing algorithms.

“Multi-player Go” by Tristan Cazenave addresses the application of Monte-Carlo Tree Search to multi-player Go. A straightforward and effective heuristic is defined. It is used in the playouts, which models coalitions of players.

“Parallel Monte-Carlo Tree Search” is authored by Guillaume Chaslot, Mark Winands, and Jaap van den Herik. It discusses three parallelization methods for MCTS: *leaf parallelization*, *root parallelization*, and *tree parallelization*. Experiments in 13×13 Go reveal that in the program MANGO root parallelization leads to the best results.

“A Parallel Monte-Carlo Tree Search Algorithm,” by Tristan Cazenave and Nicolas Jouandeau, presents a parallel Master-Slave algorithm for Monte-Carlo Tree Search. The algorithm is tested on a network of computers using various configurations.

“Using Artificial Boundaries in the Game of Go,” by Ling Zhao and Martin Müller, describes a new general framework for finding boundaries in such a way that existing local search methods can be used. By applying a revised local UCT search method, it is shown experimentally that this framework increases performance on local Go problems with open boundaries.

“A Fast Indexing Method for Monte-Carlo Go,” written by Keh-Hsun Chen, Dawei Du, and Peigang Zhang, proposes a direct indexing approach to build and use a complete 3×3 pattern library. Testing results show that their method increases the winning rates of GO INTELLECT against GNU GO on 9×9 games by over 7%, taking the tax on the program speed into consideration.

“An Improved Safety Solver in Go Using Partial Regions” is a contribution by Xiaozhen Niu and Martin Müller. The authors introduce a new technique that is able to prove that parts of large regions are safe. Experimental results show that the new technique significantly improves the performance of their previous state-of-the-art safety-of-territory solver.

“Whole-History Rating: A Bayesian Rating System for Players of Time-Varying Strength” is written by Rémi Coulom. The author proposes whole-history rating (WHR), a new method to estimate the time-varying strengths of players involved in paired combats. Experiments demonstrate that, in comparison to Elo, Glicko, TrueSkill, and decayed-history algorithms, WHR produces better predictions.

“Frequency Distribution of Contextual Patterns in the Game of Go” is a joint effort by Zhiqing Liu, Qing Dou, and Benjie Lu. They show that the Zipfian frequency distribution of Go patterns in professional games is deliberate by rejecting the null hypothesis that the frequency distribution of patterns in random games exhibits a Zipfian frequency distribution.

“A New Proof-Number Calculation Technique for Proof-Number Search” is a contribution by Kazuki Yoshizoe. The paper proposes a new straightforward

calculation technique for proof numbers. It is called *dynamic widening*. Its performance is tested on capturing problems of Go on 19×19 boards.

“About the Completeness of Depth-First Proof-Number Search,” written by Akihiro Kishimoto and Martin Müller, resolves the question of completeness of df-pn: its ability to solve any finite boolean-valued game tree search problem in principle, given unlimited amounts of time and memory. The main results are that df-pn is complete on finite directed acyclic graphs (DAG) but incomplete on finite directed cyclic graphs (DCG).

“Weak Proof-Number Search,” by Toru Ueda, Tsuyoshi Hashimoto, Junichi Hashimoto, and Hiroyuki Iida, introduces a new search idea using proof number and branching factor as search estimators. It is called *weak proof-number search*. The experiments performed in the domain of shogi and Othello show that the proposed search algorithm is potentially more powerful than the original proof-number search and its depth-first variants.

“Cognitive Modeling of Knowledge-Guided Information Acquisition in Games” is written by Reijer Grimbergen. The paper argues that Marvin Minsky’s *society of mind* theory is a good candidate for a cognitive theory to define chunks and to explain the relation between chunks and problem-solving tasks. A reproduction experiment is performed in shogi showing that perception is guided by knowledge in long-term memory.

“Knowledge Inferencing on Chinese Chess Endgames” is a contribution by Bo-Nian Chen, Pangfeng Liu, Shun-Chin Hsu, and Tsan-sheng Hsu. They propose a novel strategy that applies a knowledge-inferencing algorithm on a sufficiently small database to determine whether endgames with a certain combination of material are advantageous to a player. Their experimental results show that the performance of the algorithm is good and reliable.

“Learning Positional Features for Annotating Chess Games: A Case Study,” by Matej Guid, Martin Možina, Jana Krivec, Aleksander Sadikov, and Ivan Bratko, points out certain differences between the computer programs, which are specialized for playing chess, and their own program, which is aimed at providing quality commentary. Through a case study, the authors present an application of argument-based machine learning in order to provide their annotating system with an ability to comment on various positional intricacies of positions in chess.

“Extended Null-Move Reductions” is a contribution by Omid David-Tabibi and Nathan Netanyahu. The authors review several versions of null-move pruning, and present their enhancement *null-move reductions* (NMR), which allows for a deeper search with greater accuracy. Experimental results using their own chess program, FALCON, show that NMR outperforms the conventional methods. Here we see that the tactical benefits of a deeper search outweigh the deficiencies.

“GTQ: A Language and Tool for Game-Tree Analysis,” by Jónheiður Ísleifsdóttir and Yngvi Björnsson, presents the game tree query language (GTQL), a query language specifically designed for analyzing game trees. Moreover, the authors discuss the design and implementation of the game tree query tool (GTQT), a program that allows efficient execution of GTQL queries on game-tree log files.

“Probing the 4-3-2 Edge Template in Hex,” written by Philip Henderson and Ryan Hayward, introduces path-domination and neighborhood-domination, two refinements of domination in Hex, and uses these notions to find conditions under which probes of an opponent 4-3-2 edge template are inferior moves that can be ignored in the search for a winning move.

“The Game of Synchronized Domineering” is a contribution by Alessandro Cincotti and Hiroyuki Iida. For the game of Synchronized Domineering, the paper presents the solutions for all the $m \times n$ boards with $m \leq 6$ and $n \leq 6$. The authors also give results for the $n \times 3$ boards, $n \times 5$ boards, and some partial results for the $n \times 2$ boards.

“A Retrograde Approximation Algorithm for Multi-player Can’t Stop,” by James Glenn, Haw-ren Fang, and Clyde Kruskal, studies the computational solution of multi-player Can’t Stop, and presents a retrograde approximation algorithm to solve it by incorporating the multi-dimensional Newton’s method with retrograde analysis. Results on small versions of three- and four-player Can’t Stop are given.

“AWT: Aspiration with Timer Search Algorithm in Siguo” is a joint effort by Hui Lu and ZhengYou Xia. The paper proposes a modified alpha-beta aspiration search algorithm, which is called alpha-beta aspiration with timer algorithm (AWT).

This book would not have been produced without the help of many persons. In particular, we would like to mention the authors and the referees for their help. Moreover, the organizers of the three events in Beijing (see the beginning of this preface) contributed substantially by bringing the researchers together. The work by the committees of CG 2008 was essential for this publication. Finally, the editors happily acknowledge the generous sponsors Beijing Longlife Group, Chinese Association for Artificial Intelligence, Northeastern University, Beijing University of Posts and Telecommunications, Universiteit Maastricht, ChessBase, ICGA, and IFIP WG 14.4 Games & Entertainment Computing.

July 2008

Jaap van den Herik
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