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Preface

This book contains the papers of the Fifth Computers and Games Conference (CG 2006) held in Turin, Italy. The conference took place during May 29–31, 2006 in conjunction with the 11^{th} Computer Olympiad and the 14^{th} 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 Turin conference was definitively characterized by fresh ideas for a great variety of games. Earlier conferences took place in Hamamatsu, Japan (2000), Edmonton, Canada, (2002), Ramat Gan, Israel (2004), and Taipei, Taiwan (2005).

The Program Committee (PC) received 45 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 Out of the 45 submissions, 2 were withdrawn before the final decisions were made.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 thereafter provided that the authors submitted their contribution to a post-conference editing process. The two-step process was meant (i) to give authors the opportunity to include the results of the fruitful discussion after the lecture in their paper, and (ii) to maintain the high-quality threshold of the CG series. The authors enjoyed this procedure.

The above-mentioned set of 24 papers covers a wide range of computer games. Ten of these games are also played in practice by human players, viz., Western Chess, Chinese Chess (Xiangqi), Japanese Chess (Gunjin Shogi), Hex, Go, Lines of Action, Hearts, Skat, Lumines, and Pool. Moreover, there are three theoretical games, viz., Rush Hour, the Penny Matching Game, and One Player Can't Stop.

The games cover a wide range of research topics, including combinatorial game theory, machine learning, networked games, search, knowledge representation, and optimization.

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

"Computer Analysis of Chess Champions" by Matej Guid and Ivan Bratko compares the performance of World Chess Champions. The comparison is achieved with the help of a chess-playing program that analyzes games played by the World Chess Champions.

"Automated Chess Tutor" is authored by Aleksander Sadikov, Martin Možina, Matej Guid, Jana Krivec, and Ivan Bratko. The article describes a tutoring program which employs descriptions of tactical goals. Core mechanisms for the production of automated comments in terms of relevant goals are presented.

"A New Heuristic Search Algorithm for Capturing Problems in Go" by Keh-Hsun and Peigang Zhang Chen introduces a domain-specific heuristic for iterative-deepening that is based on third-order liberties. The search is applied to life-and-death problems in Go.

"An Open Boundary Safety-of-Territory Solver for the Game of Go" is written by Xiaozhen Niu and Martin Müller. It describes the SAFETY SOLVER 2.0. The program identifies open boundary problems under real game conditions, and generates moves for invading and defending such areas.

"Monte-Carlo Proof-Number Search for Computer Go" by Jahn-Takeshi Saito, Guillaume Chaslot, H. Jaap van den Herik, and Jos W.H.M. Uiterwijk introduces an enhancement to the Proof-Number Search algorithm. The new enhancement uses Monte-Carlo sampling to initialize proof and disproof numbers. The algorithm is tested on life-and-death problems in the game of Go.

"Virtual Global Search: Application to 9×9 Go" is authored by Tristan Cazenave. Virtual Global Search is a variation of Monte-Carlo search. Sample sequences are grouped according to their similarity under a variety of permutations in order to reduce the number of simulations. The algorithm is tested on 9×9 Go.

"Efficient Selectivity and Backup Operators in Monte-Carlo Tree Search" by Rémi Coulom describes the algorithmic framework underlying the Go program CRAZY STONE The framework develops a selective search tree by repeatedly applying Monte-Carlo evaluations at leaf nodes.

"Combinatorics of Go," written by John Tromp and Gunnar Farnebäck, presents a dynamic programming algorithm for computing the number of legal moves in $n \times m$ Go boards. For approximating this number on large boards, a formula is given. Moreover, the lower and upper bounds for the game-tree complexity of Go are mentioned (proof available at Tromp's Web site).

"Abstracting Knowledge from Annotated Chinese Chess game records" is a contribution by Bo-Nian Chen, Pangfang Liu, Shun-Chin Hsu, and Tsan-sheng Hsu. The authors introduce a method for automatically extracting knowledge from professional Chinese Chess game records. The article describes how the suggested procedure is successfully applied to about 2,000 game positions.

"Automatic Strategy Verification for Hex" is a joint effort by Ryan B. Hayward, Broderick Arneson, and Philip Henderson. The authors propose an AND/OR-tree annotation to describe Hex strategies concisely and an algorithm for verifying the correctness of Hex strategies. Both items are applied to Jing Yang's 7×7 center-opening strategy.

"Feature Construction for Reinforcement Learning in Hearts" is a contribution by Nathan R. Sturtevant and Adam M. White. The paper focuses on training a Hearts playing program by TD learning and stochastic linear regression. Special attention is directed to the underlying model for integrating features into the training.

"A Skat Player Based on Monte-Carlo Simulation," is by Sebastian Kupferschmid and Malte Helmert. The authors present a program that plays the card game Skat. The bidding engine and the card-playing engine are both based on Monte-Carlo simulation.

"A Retrogade Approximation Algorithm for One-Player Can't Stop," by James Glenn, Haw-ren Fang, and Clyde P. Kruskal, reports a retrograde approximation algorithm for solving small versions of One-Player Can't Stop based on a representation of the game as bipartite graph. The paper also gives a proof for the existence of a solution for some instances of One-Player Can't Stop.

"Improving Depth-First PN-Search: The $1 + \epsilon$ Trick" is written by Jakub Pawlewicz and Lukasz Lew. The paper introduces an improvement for Proof-Number Search algorithms. The improvement helps to reduce the space complexity in practical applications. It mainly consists of slightly loosening the proof-number boundaries for expanding sub-trees. An application of the improved search algorithm to Lines of Action and Atari Go is presented.

"Search Versus Knowledge Revisited Again" is a contribution by Aleksander Sadikov and Ivan Bratko. The article describes the phenomenon of diminishing returns in chess and the effect of domain-dependent knowledge on diminishing returns.

"Counting the Number of Three-Player Partisan Cold Games," by Alessandro Cincotti, generalizes combinatorial game theory from two-player games to three-player games and investigates lower and upper bounds for the number of three-player games born on day n. The paper also covers the number of surreal numbers born on day n.

"Lumines Strategies" is a contribution by Greg Aloupis, Jean Cardinal, Sébastien Collette, and Stefan Langerman. It describes how two parameters, the grid size and the frequency of block deletion, determine the solvability of instances of the computer game Lumines.

"Computing Proper Equilibria of Zero-Sum Games" is by Peter Bro Miltersen and Troels Bjerre Sørensen. A proper equilibrium of a matrix game can be found in polynomial time by solving a number of linear programs. An exemplary application is provided for the Penny Matching game.

"Comparative Study of Approximate Strategies for Playing Sum Games Based on Subgame Types," written by Cherif R.S. Andraos, Manal M. Zaky, and Salma A. Ghoneim, presents a scheme for evaluating different strategies of playing sums of left-excitable, right-excitable, or equitable combinatorial games. The presented evaluation scheme analyzes the strategies in greater detail than previously found evaluation schemes do.

"On the Symbolic Computation of the Hardest Configurations of the Rush Hour Game" is a paper by Sébastien Collette, Jean François Raskin, and Frédéric Servais. It describes a method for finding difficult initial configurations

for the puzzle game Rush Hour. The method is based on a representation in propositional logic and requires symbolic model checking.

"Cheat-Proof Serverless Network Games" by Shunsaku Kato, Shuichi Miyazaki, Yusuke Nishimura, and Yasuo Okabe outlines an algorithm for preventing cheating in games played on peer-to-peer networks. An example application of the algorithm to Gunjin Shogi is provided.

"Monte-Carlo Methods in Pool Strategy Game Trees" is a joint effort by Will Leckie and Michael Greenspan. The paper discusses a successful application of probabilistic search techniques to the task of choosing strategies in the game of Pool.

"Optimization of a Billiard Player — Tactical Play" is a contribution by Jean-Pierre Dussault and Jean François Landry. It compares heuristics for optimizing the choice of targets after repositioning in the game of Pool.

"Gender and Cultural Differences (If Any!): South African School Children and Computer Games," written by Lizette de Wet and Theo McDonald, reports the findings of a quantitative empirical study on the computer-game-playing behavior of school children in South Africa. The results indicate that there are no major differences in the game-playing behavior dependent on gender or culture.

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 Turin (see the beginning of this preface) have contributed substantially by bringing the researchers together. We thank Tons van den Bosch, Jahn-Takeshi Saito, and Marijke Verheij for their expert assistance in making the manuscript fit for publication. They did a very good job. Without much emphasis, we recognize the work by the committee of CG 2006 as essential for this publication. Finally, the editors happily recognize the generous sponsors Fiat Group, Sao Paolo, General Electrics, and ChessBase.

March 2007

Jaap van den Herik
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