This book contains the papers of the 11th conference on Advances in Computer Games (ACG11) held in Taipei, Taiwan. The conference took place during September 6-8, 2005, in conjunction with the 10th Computer Olympiad. It was the first time that this conference took place in Asia. The Advances in Computer Games conference series is a major international forum for researchers and developers interested in all aspects of artificial intelligence and computer-game playing. The Taipei conference was definitively characterized by new games and new ideas.

The Programme Committee (PC) received 32 submissions. Each paper was initially sent to two referees. If conflicting views on a paper were reported, it was sent to a third referee. Out of the 32 submissions, 2 were withdrawn before the final acceptance decision was made. With the help of many referees (see after the preface), the PC accepted 20 papers for presentation at the conference and publication thereafter provided that the authors submitted their contribution to a post-conference editing process. The second refereeing process was meant (a) to give authors the opportunity to include in the paper the results of the fruitful discussion after the lecture and (b) to maintain the high-quality threshold of the ACG series. The authors enjoyed this procedure.

Moreover, the PC was able to invite three key-note speakers who each opened one of the three conference days. The first invited speaker was Tony Marsland (University of Alberta), a former ICCA President. He opened the first day with the presentation “Trials and Tribulations of a Programmer.” The second day was opened by Hiroyuki Iida (Japan Advanced Institute of Science and Technology (JAIST)). His talk was titled “Towards Dynamics of Intelligence in the Field of Games.” The last day of the conference started with the invited speaker Feng-hsiung Hsu, who is well-known as the main programmer of the DEEP BLUE project. He is currently affiliated to Microsoft and so the title of his lecture was: “Hardware-Related Research at Microsoft Research Asia.”

The above-mentioned set of 20 papers covers a wide range of computer games. There are 13 games that are popular among humans too, viz., 13 Western Chess, Chinese Chess, Japanese Chess, Checkers, Lose Checkers, Amazons, Go, Poker, LOA, Mastermind, Awari, Ataxx, and Pool. Moreover, there are two theoretical games, viz., Connect and Sumbers. The games also cover a wide range of research topics, including automatic generation, optimization, opponent modeling, search, knowledge representation, and graph history interaction. The ever-reiterating choices between publication per game domain (e.g., Chess and Go) or per research topic (e.g., learning) was solved this time in favor of the game domain with an open eye to the clustering of the research topics. We start the book with a paper on opening books in Western Chess, followed by a paper on endgame databases in Checkers. Then two papers follow that present methods to generate automatically search engines or to learn parameters for search
engines in multiple domains. After a paper on a search algorithm in opponent modeling is a paper on Amazons. A group of three papers on Go is followed by two papers on Shogi. After papers on King Race, Chinese Chess, Connect, and Mastermind, a paper on multi-player chess is included. Subsequently two papers from the combinatorial game theory are presented. The sequence ends with two papers on robotic pool.

We hope that our readers will enjoy reading the efforts of the researchers. Below we provide a brief characterization of the 20 contributions, in the order in which they are printed in the book. It is a summary of their abstracts, yet it provides a fantastic three-page overview of the progress in the field.

“Innovative Opening-Book Handling” by Chrilly Donninger and Ulf Lorenz presents a heuristic in which the opening-book database is explored during the game. The main point is to avoid playing the “bad” grandmaster moves that are incidentally included in this book. The paper combines the chess expertise of a computer with some (partially dirty) statistical information. The technique is currently used in the chess program Hydra.

“Partial Information Endgame Databases” is written by Yngvi Björnsson, Jonathan Schaeffer, and Nathan Sturtevant. The paper describes a method to build selective portions of end game databases, without fully computing portions of the database that will almost never be needed. It presents a new win-loss-draw value algorithm that can build endgame databases when unknown (partial information) values are present. The paper shows that significant portions of these databases can be resolved using these methods.

“Automatic Generation of Search Engines” by Markian Hlynka and Jonathan Schaeffer introduces Pilot, a system for automatically selecting enhancements for the αβ search. Pilot generates its own test data and then uses a greedy search to explore the space of possible enhancements. Experiments in multiple domains show different enhancement selections. Tournament results further indicate that automatically generated αβ search performs at least on a par with what is achievable by hand-crafted search engines. Moreover, the automatic generation involves many orders of magnitude less effort.

“RSPSA: Enhanced Parameter Optimization in Games” is written by Levente Kocsis, Csaba Szepesvári, and Mark Winands. The authors describe an algorithm for optimization of search parameters, which combines Simultaneous Perturbation Stochastic Approximation (SPSA) with Resilient Backpropagation (RPROP). The algorithm is tested in two domains: Poker and LOA. Experiments indicate that using RSPSA is a viable approach.

“Similarity Pruning in PrOM Search” by Jeroen Donkers, Jaap van den Herik, and Jos Uiterwijk introduces a new pruning mechanism for Probabilistic Opponent-Model search. The mechanism imposes a bound on the differences between the values that the opponent models may return for each position. The authors prove two properties of PrOM-search game trees: the bound-conservation property and the bounded-gain property. These properties lead to Similarity pruning
in PrOM search. Experiments on random game trees show that Similarity Pruning increases the efficiency of PrOM search considerably.

“Enhancing Search Efficiency by Using Move Categorization Based on Game Progress in Amazons” is authored by Yoshinori Higashiuchi and Reijer Grimbergen. They propose a new method for improving the search in Amazons by using move categories to order moves. The categories are based on the likelihood of the move actually being selected as the best move, but also depend on the progress of the game. Self-play experiments show that using move categories significantly improves the strength of an Amazons program.

“Recognizing Seki in Computer Go,” by Xiaozhen Niu, Akihiro Kishimoto, and Martin Müller, presents a new method for deciding whether an enclosed area is or can become a seki. The method combines local search with global-level static analysis. Experimental results show that a safety-of-territory solver enhanced by this method can successfully recognize a large variety of local-scale and global-scale test positions related to seki.

“Move-Pruning Techniques for Monte-Carlo Go,” written by Bruno Bouzy, yields two new Monte-Carlo pruning techniques: Miai Pruning (MP) and Set Pruning (SP). In MP the second move of the random games is selected at random among a set of candidate moves. SP consists of gathering statistics about “good” and “bad” moves, pruning the latter when statistically inferior to the former. Both enhancements speed up the search at 9×9 boards. MP slightly improves the playing level. At 19×19 boards, MP results in a 30% speed-up enhancement and in a four-point improvement on average.

“A Phantom-Go Program” contains Tristan Cazenave’s contribution on the relatively new computer game Phantom-Go. The new technique introduced is based on a Monte-Carlo approach. The program called ILLUSION plays Phantom Go at an intermediate level. The emphasis is on strategies, tactical search, and specialized knowledge. The paper provides a better understanding of the fundamentals of Monte-Carlo search in Go.

“Dual Lambda Search and Shogi Endgames” is a joint effort by Shunsuke Soeda, Tomoyuki Kaneko, and Tetsuro Tanaka. The authors propose a new threat-base search algorithm which takes into account threats by both players. They applied $\lambda$-search mutually recursively so that it searches the best move by taking into account threats by both players. The search algorithm, called $\textit{dual }\lambda\text{-search}$, is implemented with DF-PN as the driver. Experiments with difficult Shogi-endgame problems show the effectiveness of the algorithm. It solves problems that even one of the strongest Shogi programs could not solve correctly.

“Chunking in Shogi: New Findings” is a contribution by Takeshi Ito, Hitoshi Matsubara, and Reijer Grimbergen. The paper focuses on cognitive experiments with expert Shogi players. The authors repeated the chess experiments by Chase and Simon with a set of next-move problem Shogi positions. The experiments show that expert Shogi players (1) search more moves, (2) search deeper and
(3) search faster than non-expert players. The experiments also show that expert Shogi players memorize the patterns of the positions and recognize move sequences before and after the position. The results suggest that Shogi players become stronger when they acquire “temporal chunks” of meaningful move sequences.

“King Race,” by Alejandro González Romero, presents the results of semi-automated rule discovery in a small chess game, called King Race. From a manually devised set of attributes and a set of test positions, a decision tree is learned. The author then derives some rules from the decision tree and proves these rules to be correct. The author believes that these techniques could be used in more complex games as well.

“The Graph-History Interaction Problem in Chinese Chess” by Kuang-che Wu, Shun-Chin Hsu, and Tsan-sheng Hsu reports an improved implementation of Chines-chess rules in a computer program. The contribution focuses in particular on the rules concerning cycles. The authors present an algorithm that deals with most of the GHI problems encountered in Chinese chess. They allow an acceptable performance degradation only. On average, 3.5% more search time is needed, but the accuracy is improved substantially. Experiments show that the algorithm can solve many of the cases that could not be solved previously.

“A New Family of k-in-a-row Games” is written by I-Chen Wu and Dei-Yen Huang. The paper introduces the game family Connect($m$, $n$, $k$, $p$, $q$) in which two players alternately place $p$ stones on an $m \times n$ board, except for the first turn when the first player places $q$ stones on the board. The player who first obtains $k$ consecutive stones of their own color, wins. The authors analyze the family of games for fairness. Moreover, the paper proposes a threat-based strategy to play Connect($\infty$, $\infty$, $k$, $p$, $q$). Finally, the authors illustrate a new null-move search approach by solving Connect($\infty$, $\infty$, 6, 2, 3).

“Exact-Bound Analyses and Optimal Strategies for Mastermind with a Lie” is a contribution by Li-Te Huang, Shan-Tai Chen, and Shun-Shii Lin. This paper presents novel and systematic algorithms to solve a variant of the Mastermind game, which is called “Mastermind with a lie.” First, a $k$-way-branching algorithm is used to get an upper bound of the number of guesses for the problem. Then a fast backtracking algorithm, based on the pigeonhole principle, is used to get a lower bound of the number of guesses. The authors show that the lowest upper bound and the highest lower bound are both 7, which means that the problem is solved completely.

“Player Modeling, Search Algorithms and Strategies in Multi-Player Games,” by Ulf Lorenz and Tobias Tschuschner, investigates a four-person chess variant in order to understand the peculiarities of multi-player games without chance components. In this contribution, player models and search algorithms are presented that have been tested in the four-player chess world. From the result follows that the more successful player models can benefit from more efficient algorithms and
speed, because searching more deeply leads to better results. Moreover, a meta-
strategy is presented that beats a paranoid $\alpha/\beta$ player, the best known player so 
far in multi-player games.

“Solving Probabilistic Combinatorial Games” is a contribution by Ling Zhao and 
Martin Müller. It discusses Probabilistic Combinatorial Games (PCG) in which 
terminal positions in each subgame are evaluated by a probability distribution. 
The distribution expresses the uncertainty in the local evaluation. The paper 
focuses on the analysis and solution methods for a special case, 1-level binary 
PCG. Monte-Carlo analysis is used for move ordering in an exact solver that 
can compute the winning probability of a PCG efficiently. Monte-Carlo interior 
evaluation is used in a heuristic player. Experimental results show that both 
types of Monte-Carlo methods work well in this special case.

“On Colored Heap Games of Sumbers” by Kuo-Yuan Kao deals with sumbers. 
These heap games are a special type of combinatorial games. Sumbers can 
describe the positions of many partisan infinitesimal game. In this paper, the author 
elaborates further on previously obtained results on sumbers and presents three 
variations of colored heap games; each of them can be solved by sumbers.

“An Event-Based Pool Physics Simulator,” written by Will Leckie and Michael 
Greenspan, presents a method to simulate the physics of the game of pool. The 
method is based on a parametrization of ball motion which allows the time of 
ocurrence of events, such as collisions and transitions between motion states, 
to be solved analytically. It is shown that the occurrences of all possible events 
are determined as the roots of polynomials up to the fourth order, for which 
closed-form solutions exist. The method is both accurate, i.e., returning con-
tinuous space solutions for both time and space parameters, and efficient, i.e., 
requiring no iterative numerical methods. It is suitable for use within a game-
tree search, which requires a great many potential shots to be modeled efficiently, 
and within a robotic pool system, which requires a high accuracy in predicting 
shot outcomes.

“Optimization of a Billiard Player – Position Play,” is a paper by Jean-Pierre 
Dussault and Jean-François Landry. It describes optimization principles to pro-
duce a computer pool player that is good both technically and in planning. The 
authors provide optimization models to compute the shots to sink a given ball 
as well as to bring the cue ball at a specified target. Some hints on planning 
optimization strategies are given.

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. Moreover, the 
organizers of the events in Taipei contributed quite substantially by bringing the 
researchers together. Then we would like to thank Ms. Tons van den Bosch for her 
assistance in making the manuscript fit for publication. Without much emphasis, 
a special word of thanks goes to the Program Committee of the ACG 11. At 
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August 2006

Jaap van den Herik
Shun-Chin Hsu
Tsan-sheng Hsu
Jeroen Donkers
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