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Július Štuller (Eds.)

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30th Conference on Current Trends in Theory and Practice of Computer Science
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30th Conference on Current Trends
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Měřín, Czech Republic, January 24-30, 2004
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Preface

The 30th Anniversary Conference on Current Trends in Theory and Practice of Computer Science, **SOFSEM 2004**, took place during January 24–30, 2004, in the Hotel VZ Měřín, located about 60 km south of Prague on the right shore of Slapská přehrada ("Slapy Dam") in the Czech Republic.

Having transformed itself over the years from a local event to a fully international conference, the contemporary SOFSEM tries to keep the best of its winter school aspects (the high number of invited talks) together with multidisciplinarity trends in computer science – this year illustrated by the selection of the following 4 tracks:

- Computer Science Theory (Track Chair: Peter Van Emde Boas)
- Database Technologies (Track Chair: Jaroslav Pokorný)
- Cognitive Technologies (Track Chair: Peter Sinčák)
- Web Technologies (Track Chair: Július Štuller)

Its aim was, as always, to promote cooperation among professionals from academia and industry working in various areas of computer science.

The 17 SOFSEM 2004 Program Committee members coming from 9 countries evaluated a record 136 submissions. After a careful review process (counting usually at least 3 reviews per paper), followed by detailed discussions at the PC meeting held on October 2–3, 2003 in Prague, Czech Republic, 59 papers were selected for presentation at the SOFSEM 2004:

- 22 contributed talks papers selected by the SOFSEM 2004 PC for publication in the Springer-Verlag LNCS proceedings volume (acceptance rate 19%), including the best paper from the Student Research Forum,
- 29 contributed talks papers that will appear in the MatFyzPress Proceedings (acceptance rate 26%),
- 9 student research forum papers (acceptance rate 38%), 8 of which will appear in the MatFyzPress proceedings.

The Springer-Verlag proceedings were completed by the 10 invited talks papers.

SOFSEM 2004 was the result of considerable effort by a number of people. It is our pleasure to express our thanks to:

- the SOFSEM Steering Committee for its general guidance,
- the SOFSEM 2004 Program Committee and additional referees who devoted an extraordinary effort to reviewing a huge number of assigned papers (on average about 24 papers per PC member),
- the Springer-Verlag LNCS Executive Editor Mr. Alfred Hofmann for his continuing trust in SOFSEM,
- Springer-Verlag for publishing the proceedings, and
- the SOFSEM 2004 Organizing Committee for a smooth preparation of the conference.

Special thanks go to:

- Hana Bílková from the Institute of Computer Science (ICS), Prague, who did an excellent job in the completion of the proceedings,
- Michal Bušta and Martin Stareček from ICS for realizing the SOFSEM 2004 web pages and a submission and review system that worked perfectly thus allowing a smooth PC session in Prague.

Finally we highly appreciate the financial support of our sponsors (ERCIM, Microsoft, Deloitte & Touche, SOFTEC Bratislava, Centrum.cz) which assisted with the invited speakers and helped the organizers to offer lower student fees.

November 11, 2003

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The Best Student Paper

Games, Theory and Applications

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Abstract. Computer game-playing is a challenging topic in artificial intelligence. The recent results by the computer programs DEEP BLUE (1996, 1997) and DEEP JUNIOR (2002) against Kasparov show the power of current game-tree search algorithms in Chess. This success is owed to the fruitful combination of the theoretical development of algorithms and their practical application. As an example of the theoretical development we discuss a game-tree algorithm called Opponent-Model search. In contrast to most current algorithms, this algorithm uses an opponent model to predict the opponent's moves and uses these predictions to lure the opponent into uncomfortable positions. We concentrate on the time complexity of two different implementations of the algorithm and show how these are derived. Moreover, we discuss some possible dangers when applying Opponent-Model search in practice.

1 Games

From the very beginning, game-playing has been studied in Artificial Intelligence. In [1] an overview is given showing that research in this domain has led to a variety of successes. Examples of computer programs that defeated the best human players occurred in Chess, Checkers, Draughts, and Othello. Still, there are many additional challenges in this area and in domains of other games. One of them is the application of knowledge of the opponent's strategy.

The idea of anticipating the opponent's strategy is not new. As a simple example (from [2]), we consider playing TicTacToe by the following ordered strategy **S**:

1. If completing three-in-a-row is possible, do so.
2. If the opponent threatens completing three-in-a-row, prevent this.
3. Occupy the central square whenever possible.
4. Occupy a corner square whenever possible.

TicTacToe is known to be drawn, and it might be questioned whether knowledge of one's opponent strategy could improve on this result. Intuitively, it seems clear that **S** should achieve a draw since it correctly evaluates the squares and acts on this evaluation. Yet, a program aware of the opponent's strategy **S** may win. Allow the program the first move as X, the following sequence of moves then causes player X to win, where at move 2 and 4 player O follows **S**.

P. Van Emde Boas et al. (Eds.): SOFSEM 2004, LNCS 2932, pp. 1–8, 2004.

X		

move 1

	O	
X		

move 2

		X
	O	
X		

move 3

		X
	O	
X		O

move 4

X		X
	O	
X		O

move 5

The win by X is due to X's awareness of the opponent's strategy **S**, admittedly non-optimal, or to rephrase this statement, due to X's successful prediction of O's moves.

2 Opponent-Model Search

OM search [3], [4], [5] is a game-tree search algorithm that uses a player's hypothesized model of the opponent in order to exploit weak points in the opponent's search strategy. The opponent model may be correct, but more frequently it may have some small errors. Therefore, it can be a possible help as well as a hindrance in playing the opponent. The OM-search algorithm is based on three strong assumptions concerning the opponent and the player:

1. the opponent (called MIN) uses minimax (or an equivalent algorithm) with an evaluation function (V_{op}), a search depth, and a move ordering that are all three known to the first player (called MAX);
2. MAX uses an evaluation function (V_0) that is *better* than MIN's evaluation function;
3. MAX searches at least as deep as MIN.

Obviously, OM search is still closely related to minimax. In OM search, MAX maximizes at max nodes, and selects at min nodes the moves that MAX thinks MIN would select.

Below we provide a brief technical description of OM search, its notation and the relations between the nodes in the search tree. Moreover, we mention a few enhancements to which adequate references are made. For an extensive description of OM search we refer to [6], [7].

OM search can be described by the following equations, in which $V_0(\cdot), V_{op}(\cdot)$ are the evaluation functions, and $v_0(\cdot), v_{op}(\cdot)$ are the node values. Subscript '0' is used for MAX values (it is not strictly necessary, but used to balance with the subscript '*op*'), subscript '*op*' is used for MIN values.

$$
\begin{aligned}
v_0(P) &= \begin{cases} \max_j v_0(P_j) & \text{if } P \text{ is a max node,} \\ v_0(P_j), \quad j = \min \arg_i v_{op}(P_i) & \text{if } P \text{ is a min node,} \\ V_0(P) & \text{if } P \text{ is a leaf node.} \end{cases} \\
v_{op}(P) &= \begin{cases} \max_j v_{op}(P_j) & \text{if } P \text{ is a max node,} \\ \min_j v_{op}(P_j) & \text{if } P \text{ is a min node,} \\ V_{op}(P) & \text{if } P \text{ is a leaf node.} \end{cases}
\end{aligned}
\tag{1}
$$

If P is a min node at a depth larger than the search-tree depth of the opponent, then $v_0(P) = \min_j v_0(P_j)$.