Go-related Research at the University of Alberta

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Abstract

We give a brief outline and references to the recent Go-related research which was performed in our group at the University of Alberta in Edmonton, Canada.

Key words: Go, game tree search, combinatorial game theory

1 Games Research at the University of Alberta

The University of Alberta is home to one of the largest games research groups in the world. We do research in many games and game-related fields, such as Poker, checkers, Othello, commercial games, and AI planning. Information about the projects currently under way can be found at `http://www.cs.ualberta.ca/~games/`. This extended abstract briefly outlines those projects that are related to the game of Go and provides a list of references for further reading on the topics mentioned in the talk. The home page of the computer Go group is `http://www.cs.ualberta.ca/~games/go/`.

2 Go-Playing Programs

Members of our group are developing two Go programs: Markus Enzenberger's *NeuroGo* [1] is based on a neural network in combination with search. It achieved excellent results on the 9×9 board. *Explorer* [6, 7] is a more traditional program based on knowledge and search. It was originally developed by the author and is now being used by several group members for their research.

In recent years, our work has focused on exact solutions to subproblems of Go, as opposed to heuristic approaches to the whole game. A major current interest is how to apply these methods in real game play. In the following sections we will briefly describe the past, present and future plans in these areas.

3 Tsume-Go and Safety of Territories

Work on Tsume-Go and the special case of the one-eye problem [4] will be described in detail in the talk by Kishimoto. Proving the safety of territories is a closely related topic. The solver developed during Xiaozhen Niu's MSc thesis research [11] greatly improves upon my previous solver, which was described at GPW in 1997.

4 Combinatorial Games and Go Endgames

Combinatorial game theory is a divide-and-conquer search model which is suitable for Go endgames. *Temperature Discovery Search* [9] is the first forward search algorithm able to compute or approximate the mean and temperature of an arbitrary loopfree combinatorial game. In experiments on sums of Amazons endgames, it convicingly outperforms full-board $\alpha\beta$ search. In [10], we started research into how to use search to achieve efficient and precise algorithms for playing sums of hot games. *Conditional Combinatorial Games* [8] are a framework that extends combinatorial game theory by modeling dependencies between subgames.

They are are expressed as nonlocal conditions that determine whether moves are legal.

5 Search Techniques

In his PhD research, Kishimoto has extended df-pn to deal with cycles as occur in Go [4]. He developed a general and efficient solution to the *graph history interaction problem* (GHI) [2, 3, 5]. This work is used in Go as well as in an ongoing attempt to solve the game of checkers `http://www.cs.ualberta.ca/~chinook/`.

6 Current Work and Future Plans

Some of the topics that we are currently interested in are:

High-level Planning in Go We are investigating models such as HTN (Hierarchical Task Network) in Go. Game-SAT [12] is an abstract model of dependencies between games.

Reinforcement Learning in Go In conjunction with Prof. Rich Sutton at the University of Alberta, we are studying new approaches for using learning in Go.

Dependency Analysis We want to develop a better model for dealing with dependent subgoals in Go. One example are endgames which are not completely separated.

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