PROJECT EXECUTIVE SUMMARY

Date: Feb-27-2013

Project Title : Analysis of iterative deepening minimax tree search using hashing based memoization for Abalone

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Keywords: Memoization, Hashing, Transposition Table, Iterative Deepening Search, Abalone, Board Games

Motivation

Memoization is yields gains in performance of complete information game-tree search when frequent repetition or overlap of game sub-trees are expected. The data structures employed for memoization and the memoized-state retention strategy are important design factors.

Previous Work

In their research paper “Exploring Optimization Strategies in Board Game Abalone for Alpha-Beta Search”, Papadopoulos A., Toumpas K. et. al. have used memoization coupled with iterative deepening search to achieve upto 25% speedup. To ensure viability of this approach, though, only a fraction of all the game states are memoized. Consequently, beginning with the same game board configuration the game-play is not idempotent, but is qualitatively optimal nevertheless. This phenomenon causes the search time to vary (apparently in a random fashion) for the same configuration.

Specific Aims

Our understanding is the features of Abalone and underlying data structures should restrict the range of the search time for a given board configuration. We seek to analyze and formulate bounds, in terms of game-specific and memoization strategy-specific variables, for the time and space utilization of the above approach.

Complexities and Challenges

The complexity of our stems from the need to model the random behavior sufficiently to aid in formulating bounds. Equally essential is ensuring the analysis is congruent to the structure and game-play of Abalone while not digressing extraneously into the nitty-gritty of computer intelligence and games. This entails establishing clear but valid assumptions to abstract details dealing with heuristics and the like.

Plan

An insight into Abalone game-play and the utility of transposition table for optimizing game-tree search therein will help us initiate our analysis and build a unique perspective too.

The next logical step is attempting to mathematically model, and analyse thereafter, the random variations in the iterative deepening search time over multiple searches rooted at the same board configuration. This will help us formulate bounds on the search time as a function of game and transposition table variables.

We can further seek any refinement avenues related to the memoization strategy to achieve

further optimization.

Deliverables

1. Interim progress report
2. Final Project Report
3. Final Presentation (if required)

Bibliography

- Papadopoulos, A.; Toumpas, K.; Chrysopoulos, A.; Mitkas, P.A.; , "Exploring optimization strategies in board game Abalone for Alpha-Beta search," *Computational Intelligence and Games (CIG), 2012 IEEE Conference on* , vol., no., pp.63-70, 11-14 Sept. 2012
- Albert Lindsey Zobrist, A New Hashing Method with Application for Game Playing, Tech. Rep. 88, Computer Sciences Department, University of Wisconsin, Madison, Wisconsin, (1969)
- Cuckoo Hashing for Undergraduates, 2006, R. Pagh, 2006.

Proposed Project Schedule

TASK	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11
Groundwork & Literature Survey	▮										
Proposal	▮										
Study of : Abalone game-play, transposition tables, hashing techniques	▮	▮	▮								
Mathematical modelling of random game-play/behavior			▮	▮	▮	▮	▮				
Exploring refinements to memoization data structures and strategy					▮	▮	▮				
Interim Progress Report					▮						
Draft Report							▮	▮			
Final Report									▮	▮	▮

W=Week

Weeks highlighted in gray are milestones (W5: Interim Progress Report due; W8: Draft Report due; W11: Final Project Report due)

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Budgeted Effort:

We estimate effort at 12 person-hours/week amounting to 132 person-hours over the span of the project i.e 11 weeks.