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An Assessment of Search Tree Heuristics for Optimizing Performance on the Three Musketeers Board Game

Abstract

The problem is one of the general family of full information abstract strategy games and is specifically of a class of games known as "hunting games," where the two sides are asymmetrical in size and have different winning goals, one usually to trap the other in some way. The solution to this problem will use domain specific adversarial search methods for general full information games. As such, the optimal algorithms and heuristics will be related to many real world game theoretic situations where there are two sides that have full information about each other. The contributions in this paper will be novel in that they focus on a situation where the adversaries are pursuing different goals and have different valid moves. In order to develop search methods, we intend to use the Minimax and Alpha-Beta searches. To optimize these, we will reduce the size of the search tree by pruning bad moves. In doing so we hope to come up with an optimal heuristic for selecting moves. Given that each player pursues a different goal, each will need a separate heuristic.

Annotated Bibliography

[1] Kuhlmann, Gregory, and Peter Stone. "Automatic heuristic construction in a
         complete general game player." AAAI. Vol. 6. 2006.
         The authors explore programs that can play more than one game, abstracting
         away from programs that are set up on a specific domain. The paper is useful for
         our purposes in that it discusses general ways to find heuristics when only given
         game specifications like the initial state, end goal, and possible moves.

[2] Michael Buro. "Improving heuristic mini-max search by supervised learning." Artificial
         Intelligence, Volume 134, Issues 1–2, 2002, Pages 85-99, ISSN 0004-3702,
         https://doi.org/10.1016/S0004-3702(01)00093-5.
         The author covers three techniques for enhancing heuristic game tree search.
         These look promising for optimizing heuristic performance on Three Musketeers.

[3] A. Papadopoulos, K. Toumpas, A. Chrysopoulos and P. A. Mitkas, "Exploring
         optimization strategies in board game Abalone for Alpha-Beta search," IEEE

This paper explores several techniques for increasing the efficiency of Alpha-Beta Search for perfect information games with a relatively low branching factor for their decision tree. This is the class and domain that our game is in and we hope to make use of some of these optimizations.