Abstract

In this study, we focus on the search indicators used in the search algorithms. The search indicators are the values given in each node in the game tree for guiding the search direction of the search algorithms. The search indicators have been used for developing a strong computer player. However, we hypothesize that there are other potentials. Under this assumption, we tried to consider a new aspect of the search indicators and to confirm its utilization.

Chapter 2 presents the previous works related to the AND/OR tree search and the conspiracy number search. Additionally, we focus on the concomitant search indicators. We explained each algorithm with focus on the search indicators. And, we provided the studies of the search indicators and tried to find the other viewpoints except the original meaning. Then, recent researches of the conspiracy number search present the good hints to us.

Chapter 3 describes a new search algorithm based on proof numbers, named DeepPN. DeepPN has three search indicators (pn, dn, *deep*) and a single parameter, R, that allows a choice between depth-first and best-first behavior. DeepPN employs two types of values, viz., proof numbers and deep values which register the depth of nodes. For measuring the performance of DeepPN, we tested DeepPN on solving Othello endgame positions and on the game of Hex. We achieved two indicative results in Othello and Hex. The algorithm owes its success to the formula in which best-first and depth-first search are applied in a "balanced" way. The results show that DeepPN works better than PN-search in the games which build up a *suitable* tree.

Chapter 4 shows the relationship between the search indicators and the evaluation of the mating problems in shogi (Tsume-shogi). We focused on the aesthetics of tsume-shogi such as interesting, beautiful and refreshing. Then, it seems a promising approach to focus on the relationship between aesthetic and complexity indicated by the proof and disproof numbers for the assessment of tsume-shogi. The indicator of the disproof number looks more promising than other factors such as the proof number and the number of visited nodes during search when using the tsume-shogi with relatively short steps in the competition. This means that the difficulty of Magire is more critical component for aesthetic.

Keywords: Search indicator, Deep Proof-Number Search, Aesthetics of mating problems, Conspiracy Number Search