

Research on the Algorithm of Six-men Chess Game

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Abstract

With the development of artificial intelligence, the game algorithm between humans and machines has also attracted the attention of many people. Among them, the algorithm of chess has fascinated countless programmers. The author has a lot of experience in the algorithm of six chess due to the influence of computer game competitions. For this reason, I will introduce some of these algorithms, such as maximum and minimum values. Algorithm, pvs algorithm.

Keywords

Artificial Intelligence; Minimax Algorithm; Pvs Algorithm.

1. Six Men Chess Introduction

Six chess, also known as Lian Liuqi. As one of the three cutting-edge technologies of the 21st century, artificial intelligence, the machine game in the field of head research is considered one of the most challenging projects. The Six Men Chess proposed by Professor Wu Yicheng has attracted a large number of players with its simple gameplay, changeable situation and rich fun, and has become one of the competition items of machine game.

2. Search Technology Introduction

2.1 Minimax Search

Minimax search algorithm or minimax search algorithm. Mainly used in zero-sum games (either win or loss, such as Go, Chess, Tic Tac Toe, etc.), complete information (the player knows all the previous steps. Chess is complete information, because the players alternate moves, and the previous steps can be Reflected on the chessboard) This algorithm is implemented recursively by the search algorithm. One layer is the first hand, denoted as a, and the other layer is the second hand, denoted as b, appearing alternately For the final position, there is a score (for example: the first win score is 1, the tie score is 0, the first loss score is -1) The first player a wants to make the score as large as possible, and the second player b wants to make the score as small as possible, so the first layer is searched and the largest return is taken, and the second layer is searched, the smallest return is taken.

2.2 Alpha-beta[8]

Of course, for a complex game, such as chess, it must take many steps to complete. This causes the number of results to grow exponentially, that is, if there are n choices in each step of the game, then after x steps, there will be n^x choices. At this time, we need to adopt a pruning algorithm (Alpha-Beta) to reduce the amount of computation. From the name of the pruning algorithm, we can see that this algorithm allows us to cut off some branches in the tree graph, thereby reducing the amount of calculation.

2.3 Pvs[9]

The PVS algorithm, also known as the minimum window search algorithm, is transformed from alpha-beta. The main difference between the two is that all nodes except the main variable perform a zero window search, and the value of α is copied to the value of β . Normally, all the child nodes of each node are sorted, and at the same time Assuming that the first node is the best, as the main variable, a full-window search is performed. Through the zero window search, it is judged whether there is a value of $\alpha \leq \beta$, and the pruning of the game tree is carried out on this basis. Among them, sorting the nodes is the most critical step of the algorithm, which greatly improves the search efficiency.

3. Introduction to Available Walking Method Generation

Movement generation refers to the part of the program that lists all the possible moves of a situation, that is, the module used to tell other parts where to go next. The rules of various chess types are different, and the complexity of the movement generation is also very different. Generally speaking, in a chess game, the more types of chess pieces on both sides, the more rules of movement of various pieces, and the more complicated the realization of movement generation in the program.

For Chinese Chess, there are 16 pieces that can be moved by both sides at most, and the movement of "horse" chess is up to 8 empty positions. The width of this game tree is very narrow. For Six Men, the 19x19 board has a maximum of 361 vacancies to choose from, and except for the first step where both sides play two pieces, the maximum possible search width is $360 \times 359 / 2 = 64620$, for each level of index increase search In terms of volume, it is obviously inappropriate for the full search of the chessboard. Reducing the search width is the only way to improve the chess power, which leads to the following algorithm.

4. Vacancy Valuation Ranking

The generation of moves is an important research content of Six Men Chess. If we can estimate each vacancy, we can select a limited window to search the game tree according to the value of the vacancy. The specific method is:

- (1) According to the concept of roads, get the pawns owned by each road and the party that the road belongs to.
- (2) Add points to the empty positions on the road according to the existing chess pieces and the bonus table in the road.
- (3) Scan each vacancy, sort the vacancy scores in descending order, and extract the first n (n =set search width) vacancies into the available vacancy table for the next search.

The specific pseudo code is as follows: The vacancies obtained in this way are sorted by value. If the pvs algorithm is applied, the search efficiency of the game tree can be improved. In the pvs algorithm, sorting the nodes is the most important step of the algorithm. In addition, for the algorithm of vacancy estimation, readers can think about further optimization methods. Professor Wu Yicheng mentioned in his article: Use a decreasing sequence for the width of each layer (w_1, w_2, \dots, w_i), such as $w_i = w_{i+1}$. Further reduce the number of branches.

5. Algorithm Efficiency Comparison

Alpha6R is a six-piece game program based on space estimation and sorting search methods. The fixed search width is 14 spaces, and each level of search will generate 91 different moves. The time comparison between this method of generating method and the full search method is performed, and the results are shown in the following table.

Table 1. Comparison of algorithm efficiency

Search depth	Full search	Vacancy valuation ranking
One layer	Two seconds	One second
Two layers	Twenty five seconds	Five seconds
Three layers	One thousand and sixty two seconds	Twenty one seconds

6. Conclusion

The method of generating moves of vacancy estimation and sorting can improve the problem of excessive search width for each layer of the game tree of Six Men, reduce unnecessary search time, deepen the search depth, and improve the chess power of the program. At the same time, it can also be used in the pvs search technology to improve the pruning efficiency of the game tree.

The disadvantage of empty position evaluation is that the evaluation of the chess position is incomplete, and moves that exceed the search width will be ignored. This brings about the problem that the best possible moves are ignored, and the chess position becomes unfavorable. Own form. And this problem may be alleviated by the method of Professor Wu Yicheng mentioned in this article, and a wider search can be carried out on the shallow layer.

Acknowledgments

Fund:2021 National College Students Innovation and Entrepreneurship Training Project (Project No.: 202110146025).

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