

COMS3008: Parallel Computing Assignment

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Introduction

The game of peg solitaire is a one player game played on a 33 holed cross shaped board that involves jumping pegs over other pegs, in a manner similiar to checkers. The rules are as follows:

1. A move consists of jumping a peg over an orthoganal neighbour into an empty space. The peg that was jumped over is then removed from the board.
2. Pegs can only jump onto an empty space.
3. The game is won if the final peg is in the centre space.
4. If no pegs can legally move or the final peg is not in the centre the game is lost.

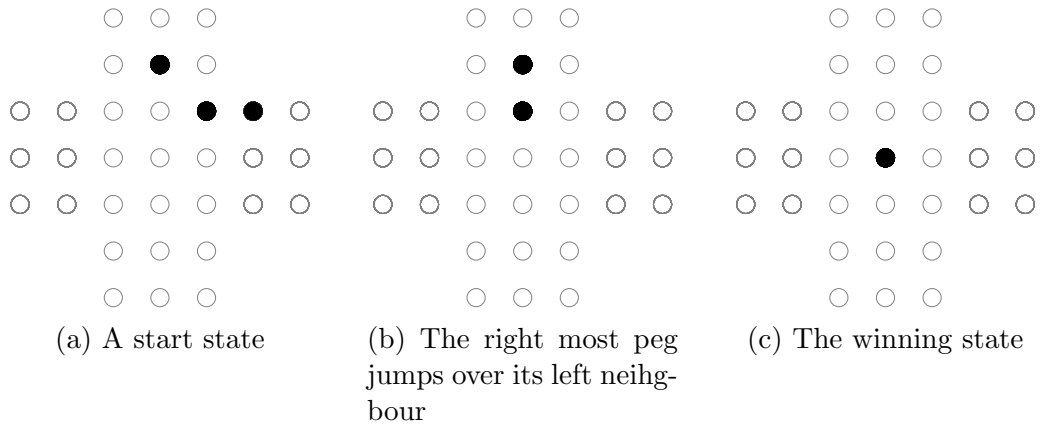


Figure 1: A winning set of valid moves

Backtracking Search

Recursive backtracking using depth first search was chosen as the method for state space exploration. The standard backtracking depth first algorithm is as follows:

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input : An initial, valid board state
output: A sequence of moves to get from the initial state to the
        winning state

result  $\leftarrow$  Empty list to store moves from the initial state to the
        winning state legalMoves  $\leftarrow$  A list of all the legal moves for the
        current board;
state  $\leftarrow$  The current state;
foreach m in legalMoves do
    | state  $\leftarrow$  The state achieved by performing m;
    | if state is winning state then
    | | return move;
    | else if state has no legal moves then
    | | return Null;
    | else
    | | return BacktrackingDFS(state);
    | end
end
```

Algorithm 1: A standard recursive backtracking using DFS

But because pegs are identical, game states where pegs are in the same position are identical, regardless of the moves taken to arrive at that state. Thus exploring the state space looking for a sequence of states leading to the winning state will probably involve evaluating the same states many times. Thus a significant speed up can be achieved by saving states that are known to not lead to the winning state so that any previously visited infeasible states children don't need to be explored thus reducing the depth of that search.

Serial Implementation

Parallel Implementation

Results