Project 3 Problem Formulation

Ryan Canfield
Antonio Craveiro
William Hancock
3/23/2023

Type A: alpha beta pruning with iterative search

<u>Problem Formulation</u>
You must provide a formal problem formulation along with your code.

1. States: The various legal board states: Think of each of the board locations as a trinary number: It contains a white piece, a black piece, or no piece. Which board state(s) is the initial state? Do you need other information to be stored in a game State?

GIPF
37 possible places to put a tile each tile spot can be either white piece black piece or no piece, 3^37 possible outcomes we can limit it to 37 choose 15 (we only have 15 pieces) and 22 choose 15
Branching factor is 42 (24 * 2 - 6)

The initial state would be the board with no pieces on it. Other information includes the number of pieces both players have left in reserve, The number of Gipfs both players have Remaining, The locations of the black and white pieces on the board, who's turn it is, and the amount of pieces on the board for each player.

2. Actions: What are an agent's possible actions?
The actions that the agent can take are pushing a piece on the board in one of the 24 different spots, and setting the number of Gipf pieces at the beginning of the game.

3. Transition Model: What takes place when a move occurs? Describe the format of the successor state.
When a move occurs, a piece is pushed onto the board, moving all of the other pieces in that row in the same direction. If there is a four in a row, then all the pieces on that row are removed The successor state will have the result of the piece placed, any pieces pushed or removed, and the updated states of the players material in reserve.

4. TerminalTest(s): What do the terminal states of the game look like?
There are two terminal states for the game. The first one is where you or your opponent have all of their Gipf pieces removed off the board. The second terminal state is where you or your opponent run out of pieces/materials and can not place a piece on the board. We define the utility of a terminal state as 0 for loss, and 1 for win.

5. Eval(s,p): Describe your evaluation function. What criteria do you use? Be thorough.

Our evaluation function considers the percentage of gipfs that an agent has on the board, the percentage of normal pieces that the agent has on the board, and the percentage of pieces in hand that the agent has. Each part is linearly weighted and added together, so the maximum value the function can be is 1. By the same principle, our evaluation function has a lower bound of 0. This is between our definition of utility and thus is a valid evaluation function.

Eval = 0.4 * (agentGipfs) + 0.4 * (agentPieces) + 0.2 * (agentPiecesInHand)