Theory questions AI

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1 AI

1.1 Describe the possible states, initial state, transition function.

Tic-tac-toe:

- The possible states are all boards(4x4) where both players have placed the same amount of pieces or the first player has placed one more piece on the board than the opponent. In addition, the board does not have more than one 4-in-line (end of the game).
- The initial state is the empty board.
- The transition function μ is, given a possible state and the player's turn, the same board but one of the empty cells now contains a piece corresponding to the player who moves.

Checkers:

- The possible states are all boards (8x8) where there are between 0 and 12 checkers of every color (between normal and king pieces) only occupying black squares.
- The initial state is in Fig. 1.
- The transition function μ is, given a possible state and the player's turn, the same board where the player has to move one of its checkers: diagonally forward to an adjacent cell if it's a normal checker, diagonally to an adjacent cell if it's a king checker or jumping if there's the possibility. If a checker gets to the last row, it becomes a king checker.

1.2 Describe the terminal states of both checkers and tic-tac-toe.

Tic-tac-toe: A player wins if they place 4 pieces in a row. The game results in a draw if no one has won when the gameboard is full and there are no more moves left.

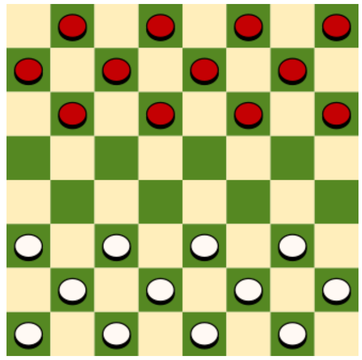

Figure 1: Checkers initial state.

Checkers: "A player wins by capturing all the opponent's pieces, or by leaving the opponent with no valid moves. If no pieces are captured for 50 turns (25 of each player), the game is considered a draw." (From Kattis description)

1.3 Why is ν(A, s) = #white checkers - #red checkers a valid heuristic function for checkers (knowing that A plays white and B plays red)?

Because the white player wants to have many pieces left and that the opponent has as few as possible left, because then they are probably *closer* to winning, therefore making it a good heuristic.

1.4 When does ν best approximate the utility function, and why?

In the beginning when there are no moves that are close to a win or loss.

1.5 Can you provide an example of a state s where ν(A, s) $>$ 0 and B wins in the following turn? (Hint: recall the rules for jumping in checkers)

Player A might have 2 pieces left and player B only one but player B might win anyway if A's pieces are positioned in such a way that B can jump over both of them in one round.

1.6 Will η suffer from the same problem (referred to in the last question) as the evaluation function ν?

Yes, as it does not take into account how close the win is. Player A might have 10 possible ways of winning the game in 2 turns but player B might have 1 that is the next turn.