# Game Playing with Minimax

A variation of Mancala with Alpha-beta Pruning

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**State Space**
The state space is an array of size 24. The positions [1, 2, 9, 10, 11, 13, 14, 21, 22, 23] belong to player 1 and the positions [3, 4, 5, 7, 8, 15, 16, 17, 19, 20] belong to player 2. Player 1's mancala is stored in positions [0, 12] and player 2's mancala is stored in positions [6, 18]

During the minmax search, two other identical arrays are used to predict the other players future moves.

**Heuristic1**
Heuristic 1 consists of the players trying to maximize the number of rocks in their mancalas. Player 1 will first expand its production system, and then for each of those state, it will expand player 2's production system. Imagine an array of arrays, from each array, the state the gives the minimum number of rocks is chosen (assuming player 2 is just as smart as player 1), now you have a single array with all possible player 2's moves, from that array, player 1 will choose the state that gives them the maximum number of rocks in their mancala.

**Heuristic 2**
Heuristic 2 consists of the players trying to maximize the number of empty holes on the player' side. Player 1 will first expand its production system, and then for each of those state, it will expand player 2's production system. Imagine an array of arrays, from each array, the state that will minimize the number of empty holes in player 1's side (, now you have a single array with all possible player 2's moves, from that array, player 1 will choose the state that gives them the maximum number of holes in their side.

**Node Count**

| | With Alpha-beta | Without Alpha-beta | Difference | Rounds |
|---|---|---|---|---|
| **H1 vs H1** | 4686 | 5460 | 774 | 23 |
| **H2 vs H2** | 2891 | 3780 | 889 | 33 |
| **H1 vs H2** | 4425 | 5460 | 1035 | 26 |
| **H2 vs H1** | 6048 | 6930 | 882 | 30 |