

Build a Game-Playing Agent – Heuristic Analysis

Stephan Kurpjuweit

Implemented Heuristic

I implemented the following heuristics:

1. Heuristic Custom_2:

Maximize the distance from the other player. (Idea: Move to another area of the board.)

2. Heuristic Custom_3:

Maximize the distance from the other player, but also minimize distance to the center of the board. (Idea: Stay away from corners.)

3. Heuristic Custom_4:

Minimize the distance to the blank fields. (Idea: Move to an area of the board, in which there are lots of blank fields available to increase future choices.)

4. Heuristic Custom_5:

Maximize the open moves available after the next move. (Statically calculate the sum of open moves of all fields the player could move to from the current position.)

5. Heuristic Custom_6:

Maximize the open moves available after the next move. (Statically calculate the sum of open moves of all fields the player could move to from the current position.) Balance it against the moves available to the opponent after the next move (like the improved open move score).

6. Heuristic Custom_7:

Maximize the open moves available after the next move. (Statically calculate the sum of open moves of all fields the player could move to from the current position.) Balance it against the moves available to the opponent after the next move (like the improved open move score). Also consider, that the opponent could move to one of the fields in the next move. The open moves from these fields are not counted.

Performance Test Results

I implemented the following heuristics:

	AB_Improved	Custom_2	Custom_3	Custom_4	Custom_5	Custom_6	Custom_7
Random	19:1	16:4	14:6	15:5	16:4	18:2	18:2
MM_Open	14:6	13:7	12:8	9:11	8:12	14:6	15:5
MM_Center	14:6	17:3	15:5	11:9	17:3	18:2	16:4
MM_Improved	11:9	11:9	13:7	6:14	15:5	15:5	14:6
AB_Open	8:12	7:13	11:9	7:13	12:8	12:8	7:13
AB_Center	11:9	10:10	10:10	8:12	10:10	12:8	13:7
AB_Improved	8:12	12:8	11:9	8:12	12:8	11:9	9:11
Win Rate	60.7%	61.4%	61.4%	45.7%	64.3%	71.4%	65.7%

A direct comparison of Custom_6 and AB_Improved in 200 matches shows a win rate advantage for Custom_6 of 56% vs. 44%.

Recommendation and Discussion

I recommend using Heuristic Custom_6. Reasons:

1) It follows the same idea as AB_Improved, but takes the quality of the open fields into account as an additional signal.

2) It constantly seems to be slightly better than AB_Improved (see data above). A direct comparison of Custom_6 and AB_Improved in 200 matches shows a win rate for Custom_6 of 56.

3) An additional improvement idea of the heuristic (as implemented in Custom_7) seems to be counter-productive.

The other heuristics (Custom_2, Custom_3 and Custom_4) perform worse than expected. The reason is that the idea behind these heuristics most likely only hold true in large board configurations. In small boards, where both players move around the entire board a lot, the heuristics do not provide enough information. Another reason might be the fact that the heuristics do not consider the state of the match (e.g., if the board is mostly filled up during end game). Considering the state of the match would also be my suggested direction to define and explore additional heuristics.