Heuristic Analysis

Among the three custom heuristic functions, open_first_plus_second_move_heuristic function has the highest average winning rate as 70% out of 5 tournaments conducted on the same hardware with identical environment variable settings.

The other two heuristic functions, open_second_move_heuristic and improved_open_second_move_heuristic, have the winning rate of 67% and 61% respectively.

The open_first_plus_second_move_heuristic is build base on the idea of open_move_heuristic and inject even more knowledge to the heuristic so that the calculation tells more about the game state. It has a stable and outstanding performance toward the random and minimax opponents according to figure 1.

Win rate% (50 matches)	AlphaBetaPlayer (baseline)	AlphaBetaPlayer w/ open second move heuristic	AlphaBetaPlayer w/ improved open second move heuristic	AlphaBetaPlayer w/ open first + second move heuristic
Random	92%	90%	88%	92%
MM_Open	66%	78%	78%	86%
MM_Center	88%	88%	82%	82%
MM_Improved	66%	66%	58%	86%
AB_Open	58%	46%	38%	50%
AB_Center	56%	50%	40%	50%
AB_Improved	52%	50%	44%	42%

Figure 1- winning rate of challengers

(100%-80% Green/ 80%-60% Yellow/ 60%-50% Red/<50% Grey)

The open_first_plus_second_move_heuristic can be improved by injecting the opponent's state. But we need to be careful when we add more knowledge to the heuristic function since it makes the calculation heavier at the same time.

Moreover, changing the selection of the heuristic along different stages in the match is also a great idea (similar to human players switching their strategy in the middle of a game).

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