

Heuristic Analysis

Heuristics

Three different custom-evaluating functions have been used for this analysis. These functions are:

- **Defensive:** this heuristic tries to move away from the opponent and prioritizes having multiple options to move around, limiting the opponent's moves.
Later in the game, when there are few movements left, the heuristic changes its behaviour: distance is no longer a primary guideline; having several options to move becomes paramount.
- **Aggressive:** the opposite version of the Defensive heuristic, this one tries to get closer to the opponent and values limiting the opponent's moves.
In the same way, later in the game, the heuristic focuses on limiting the opponent's options to move and distance is no longer taken into consideration.
- **Improved Weighted:** a weighted version of the improved heuristic, where the number of your movements is three times more important than the number of the opponent's movements.

Results

The table below shows the results after 100 matches per opponent. The number of matches has been raised from the original five after observing important deviations in the results of successive runnings.

	AB Improved		Defensive		Aggressive		Improved Weighted	
	Won	Lost	Won	Lost	Won	Lost	Won	Lost
Random	177	23	189	11	177	23	176	24
MM Open	115	85	137	63	131	69	126	74
MM Center	154	46	172	28	169	31	159	41
MM Improved	109	91	113	87	115	85	112	88
AB Open	99	101	109	91	114	86	105	95
AB Center	89	111	119	81	106	94	100	100
AB Improved	105	95	115	85	109	91	107	93
	60.6 %		68.1 %		65.8 %		63.2 %	

Defensive heuristic seems to be the better strategy, with almost 70% of total victories, closely followed by the Aggressive heuristic.

However, Random and Minimax players do not perform very well against these and other heuristics that have been tested. Besides, as our heuristics use AlphaBeta, we think it makes more sense to test them just against other AlphaBeta opponents. In this case, the number of victories are not so good but above average.

	AB Improved		Defensive		Aggressive		Improved Weighted	
	Won	Lost	Won	Lost	Won	Lost	Won	Lost
AB Open	99	101	109	91	114	86	105	95
AB Center	89	111	119	81	106	94	100	100
AB Improved	105	95	115	85	109	91	107	93
	48.83 %		57.16 %		54.83 %		52 %	

We do some more test. In this case, we do five rounds of five matches of our heuristics against others AlphaBeta opponents. The results are in table below:

	Round 1	Round 2	Round 3	Round 4	Round 5	Mean	STDEV
Defensive	56.67%	60%	56.67%	53.34%	60%	57.23%	2.78
Aggressive	46.67%	53.34%	63.34%	53.34%	53.34%	53.49%	5.96
Im. Weighted	50%	56.67%	40%	46.37%	60%	49.65%	7.95

According to the data, Defensive heuristic has still a long way to go to improve, but it is the best between the three agents and the one we recommend. We base our recommendation on its higher percentage of overall winnings. Besides, in the five rounds tournament, Defensive heuristic has the higher mean, the lower standard deviation and in no round it goes below 50% of victories. We are also taking in consideration that the heuristic is simple, easy to implement and does not add excessive complexity to the agent. Finally, we think the ability to change its behaviour near the end of the game adds some variability and allows it to adapt better to the environment.