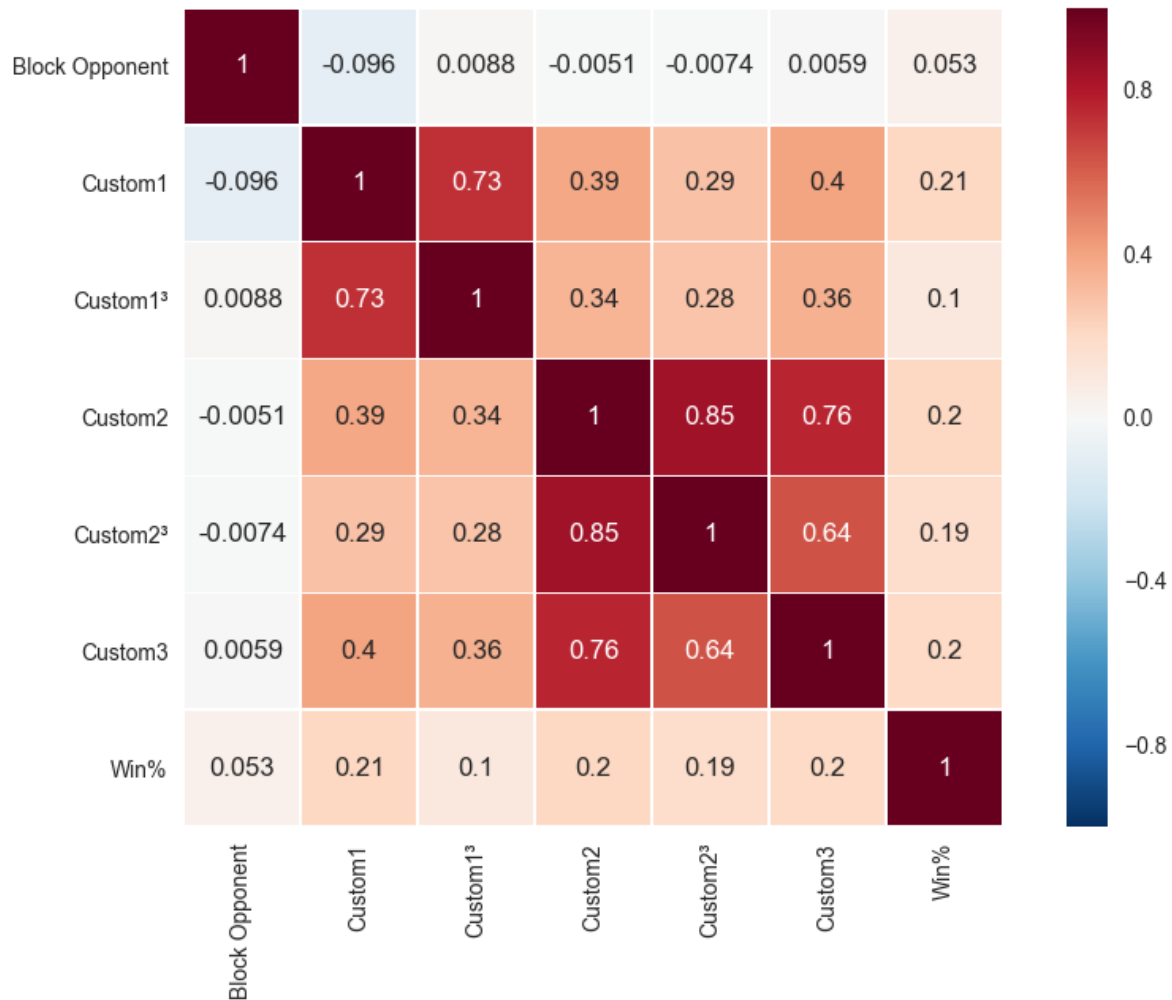


1 Heuristic Analysis

Several heuristic score functions have been examined in the process of the heuristic analysis. Therefore 500.000 games between two players choosing random moves have been sampled to look at the correlation between the sums of the individual score functions over complete games and the win-percentage in those games.



Several more functions have been examined, as well as combinations of those functions, but describing every single function would go beyond the scope of this paper. The three best performing functions are presented in detail below. For brevity we will refer to the acting player as 'hero' and to his opponent as 'villain' in the function descriptions.

1.1 Custom₁

Returns the difference between the number of available moves to hero and twice the number of available moves to villain. The number of villain's moves is multiplied by two, in order to punish him harder for having zero available moves. This function intuitively makes sense, because it accurately describes hero's goal of the game: minimizing villains moves while still being able to move himself. It has had the best overall performance with a 70.9% win rate and therefore has been chosen as the primary score function.

1.2 Custom₂

Returns the difference between hero's squared distance to the board's center and villain's squared distance to the center. In general we have most options to maneuver the board when we occupy the center square, which is why this seems to be a reasonable heuristic to test. With a 66.1% win rate it scored only a little worse than the 1st score function and this could be due to variance, however based on the knowledge we have it seems reasonable to choose this as the secondary score function.

1.3 Custom₃

Returns a score that describes how much either player has been pushed onto one side of the board. It is calculated by first checking if both players are positioned on any same side of the board and if so, the distance to the board's center for the player closest to it is taken. This function tries to mimic the strategy of pushing a player to one side of the board. However since players don't move in straight lines, but in an L-shape instead, this is harder to do, which is probably why this function did not perform as well as was hoped. With 65% it performed worst among the three chosen score functions. It is also less comprehensible and therefore ranks third.

1.4 Results

The Alphabeta agent has been tested in a tournament with each of the score heuristics against seven other players. There have been 100 fair matches against each of those agents. The results are presented below.

	Custom ₁	Custom ₂	Custom ₃
	Win / Loose	Win / Loose	Win / Loose
Random	187 / 13	183 / 17	186 / 14
MM Open	155 / 45	140 / 60	138 / 62
MM Center	185 / 15	166 / 34	164 / 36
MM Improved	142 / 58	141 / 59	133 / 67
AB Open	105 / 95	94 / 106	92 / 108
AB Center	119 / 81	104 / 96	105 / 95
AB Improved	99 / 101	98 / 102	92 / 108
Win Rate	70.9%	66.1%	65.0%

As mentioned, the Custom₁ function had the best results against all agents. It only ties against 'AB Improved', because that agent uses the same scoring heuristic. It is also a very simple to understand, yet meaningful heuristic, since it reflects the overall goal of the game. That's why it is the recommended scoring function.

1.5 Conclusion

The overall performance looks promising with a 70.9% win rate for the best agent, however if we look at the performance against other alpha-beta agents, we perform just slightly better than 50%, which could probably be improved upon in some way. However, during the analysis no combination of score functions could be found that outperformed the difference in the available number of player moves.