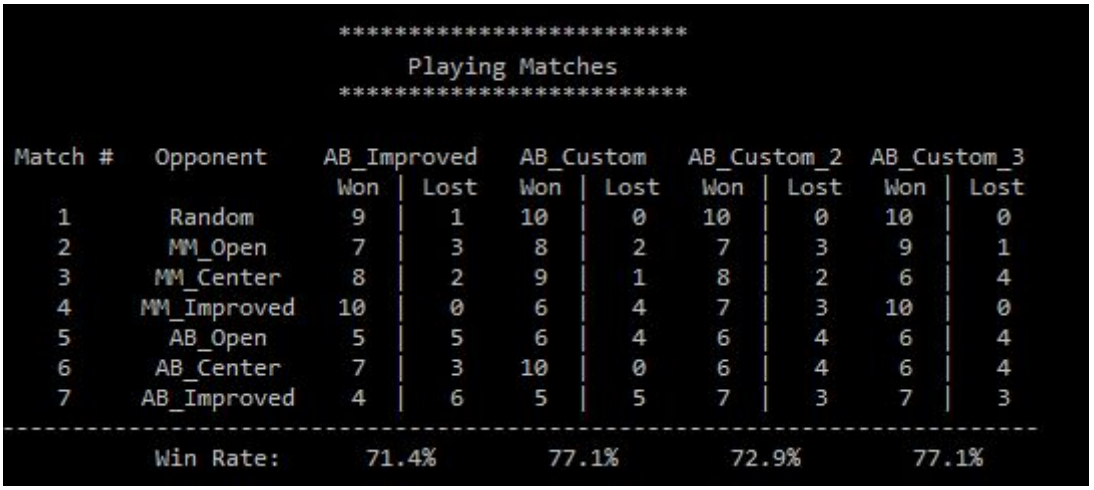
Heuristic Analysis

Here are the analysis of the 3 heuristics used for Isolation project:

1. Custom_score: This one is based on heuristic introduced in the video Udacity. Primary idea behind the heuristic is aggressive approach that prefer to choose moves which allow move advantage over opponent player and at the same time seek this advantage more at beginning of the game. w = 20 / (“number_of_plys_till_now” + 1)
2. Custom_score_2: This is one of the more complex heuristics, in first part it is trying to take advantage of difference between already used tiles and empty ones (this is significant mainly at the beginning of the game). Second part emphasize moves that do not lead to positions next to game board for current player and opposite for opponent. score += 1 - “(total tiles - remaining empty tiles) / total tiles” * “is near wall” (opponent: score -= 1 - “(total tiles - remaining empty tiles) / total tiles” * “is near wall”)
3. Custom_score_3: This heuristic is the exact implementation of the base one introduced in the video Udacity. This heuristic is based on preferring decisions which leads to positions that have more possible move in the future. (my_move - (2 * opponent_move + 1e-2))

Table below shows result of all three previously mentioned heuristics against benchmark agent (AB_Imporoved).



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                      ************************
                           Playing Matches
                      ************************

Match #   Opponent    AB_Improved   AB_Custom   AB_Custom_2  AB_Custom_3
                      Won | Lost   Won | Lost   Won | Lost   Won | Lost
   1       Random      9  |  1     10  |  0     10  |  0     10  |  0
   2       MM_Open     7  |  3      8  |  2      7  |  3      9  |  1
   3      MM_Center    8  |  2      9  |  1      8  |  2      6  |  4
   4     MM_Improved  10  |  0      6  |  4      7  |  3     10  |  0
   5       AB_Open     5  |  5      6  |  4      6  |  4      6  |  4
   6      AB_Center    7  |  3     10  |  0      6  |  4      6  |  4
   7     AB_Improved   4  |  6      5  |  5      7  |  3      7  |  3
--------------------------------------------------------------------------
          Win Rate:      71.4%        77.1%        72.9%        77.1%
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Recommandation

As can be seen on the screenshot above the most consistent winning heuristic is Custom_score_3 which do not lost to any other tested agent, despite sharing the winning rate (77.1%) with Custom_score_1 it seems still superior as the Custom_score_1 suffered draw against benchmark agent (AB_Improved). Custom_score_2 seems to be lacking in the performance and combined with its complexity, it does not look like good choice.

According to the result, complexity and scalability is safe to recommend Custom_score_3 as heuristic of choice. Arguments that support this are:

1. Game performance: Aggressive approach with preferring choices that allow is more move that opponent in future is the best choice found till now. This also make sense in way that isolation game losing condition is zero possible moves on player side. Custom_score_3 seems to be the best choice here.
2. Computation cost: Custom_score_2 requires multiple conditional iteration over our and opponent moves compared to simple arithmetic calculation needed for Custom_score_1 and Custom_score_2 leads us to conclusion that it have higher computation cost. Custom_score_1 and Custom_score_3 costs are comparable.
3. Depth searched: Depends on algorithm (it is same for all heuristics), depth condition (also same for all heuristics) and computation cost -> the lower the cost the deeper we can get. Thus we can again choose from as they have similar cost Custom_score_1 and Custom_score_3.
4. Approach to opponent:
    a. Custom_score_1 - Take interest only in number of moves opponent have, but with lower priority during late game. Otherwise do not care about opponent position or overall board situation. Result: This heuristic may lack prioritization in the late game.
    b. Custom_score_2 - Take interest in both opponent moves and his position on the board -> looking for overall board advantage. Result: This heuristic take significant care of the opponent and game situation.
    c. Custom_score_3 - Take interest only in number of moves opponent have with same priority during whole game. Otherwise do not care about opponent position or overall board situation. Result: Simple heuristic with good condition prioritization till the late game despite only focusing on opponent.

The only problem with aggressive approach may be that from a certain degree we may face “greedy” mode when the agent is going to rate even decent moves with low score.

Possible improvement: Fine tuning the weight -> require lot of try and adjust tests.