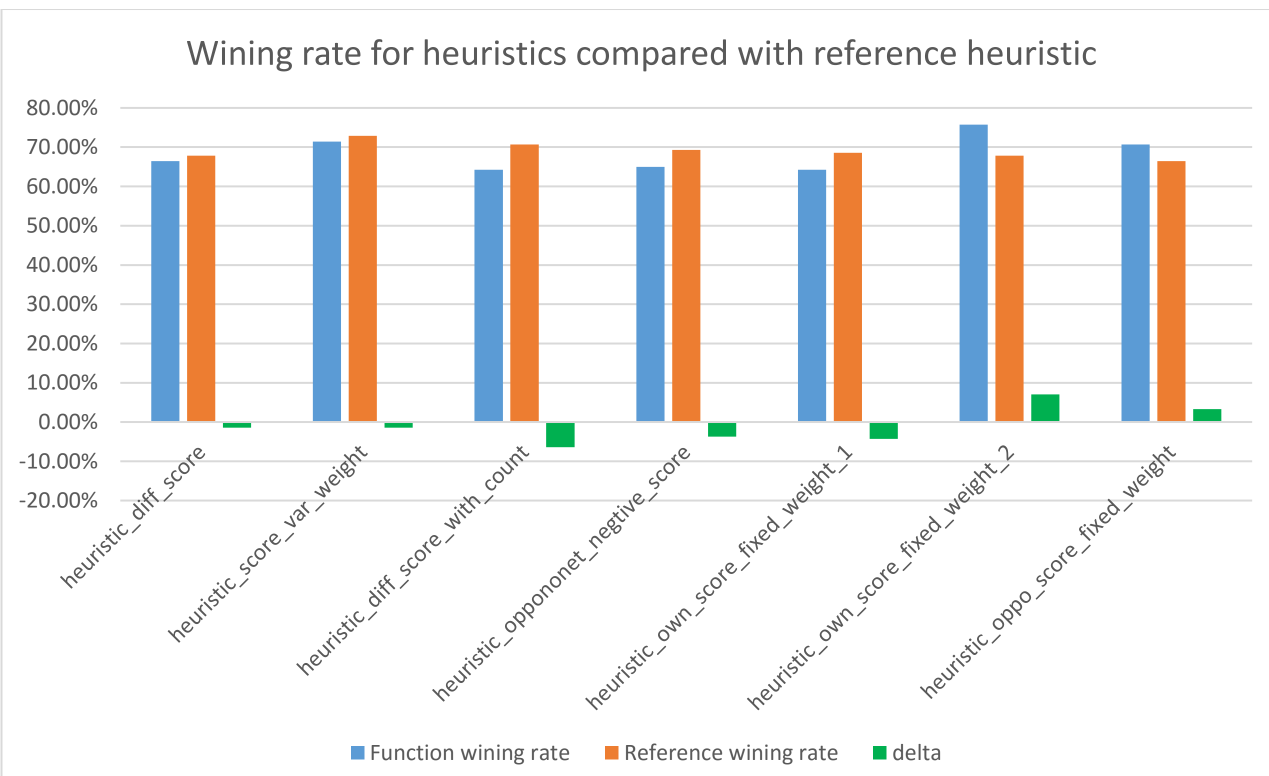
Analysis of heuristic functions in Isolation game

Totally 7 heuristic functions are tested. Listed below:

Function name	Function implementation
heuristic_diff_score	own_moves - opp_moves
heuristic_score_var_weight	own_moves/game.move_count
heuristic_diff_score_with_count	own_moves - opp_moves - game.move_count
heuristic_opponent_negtive_score	-opp_moves
heuristic_own_score_fixed_weight_1	2*own_moves - opp_moves
heuristic_own_score_fixed_weight_2	own_moves/2 - opp_moves
heuristic_oppo_score_fixed_weight	own_moves - 2*opp_moves

And the wining rate data of different heutistic functions listed below:

Function name	Function wining rate	Reference wining rate	delta
heuristic_diff_score	66.43%	67.86%	-1.43%
heuristic_score_var_weight	71.43%	72.86%	-1.43%
heuristic_diff_score_with_count	64.29%	70.71%	-6.42%
heuristic_opponent_negtive_score	65.00%	69.29%	-3.71
heuristic_own_score_fixed_weight_1	64.29%	68.57%	-4.26%
heuristic_own_score_fixed_weight_2	75.71%	67.86%	7.05%
heuristic_oppo_score_fixed_weight	70.71%	66.43%	3.28%



The first function is actually the same with the ID_improved function, but we can see the wining rate is somehow different. This means the wining rate is not stable even for the same heuristic in the same tournament. So if your function cannot over-perform the reference more than like 2 percent delta constantly, it is not a valid prof that your function is better.

heuristic_score_var_weight and heuristic_diff_score_with_count introduces the move_count variable which doesn't help and it improves the calculation time, affecting the search depth.

heuristic_opppononet_negtive_score simply uses the negative score of the opponent's move, its performance is worse than ID_improved which proves that we should both take into account of my_move as well as opponent_move like ID_improved.

Moving on, how to outperform the ID_improved? Let's first try to improve the weight of my_move using heuristic_own_score_fixed_weight_1, the performance becomes worse. I think the this is expected because this will make our decision less related with the opponent's status. Then let's try to follow the directions from the class lecture to lower my_move's weight heuristic_own_score_fixed_weight_2 or to improve the weight of the opponent's moves (heuristic_oppo_score_fixed_weight) , the performance finally out-performs the ID_improved, which validates that when the computer tries to get in the way of the opponents moves in an aggressive manner rather than just thinking the left moves of itself, it can yield a better result.

Since heuristic_own_score_fixed_weight_2 which lower's my_move's weight to 0.5 has the best performance, so I choose this function in the task. heuristic_oppo_score_fixed_weight which improves the weight of opponent's moves to 2 uses the a similar idea, yet it has a smaller winning rate. It needs more deep dive to figure out why. Currently I prefer to say it is random as their performance is not stable.

From other unsatisfactory heuristics, we can learn that 1. Sometimes more variables and thus more calculation is not worthy it, because it will case the search depth shallow. 2. Just like when we are playing a game, our ultimate goal is to make our opponent has no choice rather than how many choices 'we' still have. If we apply this notation in the heuristics to let our opponent's available moves less when we make choices, like we are chasing our opponent in the game, will make us win quicker and somehow avoid the "horizon effect".