Candidate: Miodrag Vujkovic

Heuristic Evaluation for Isolation Game Agent

For this project, I have made 4 heuristic functions. Description and analysis is presented below.

Heuristic_1

Score is calculated with the following formula:

score = (a - 3b)*c, where:

a : number of legal moves for player 1

b : number of legal moves for the opponent

c : number of already taken fields

This is an arbitrary function, but it provides pretty good results.

Heuristic_2

Score is calculated in two phases:

First, we check if board is divided between players by already taken fields, which would mean that players are playing on two separate smaller boards. In that case, player with more legal moves will certainly win regardless of other player's strategy.

If the board is not divided, we just calculate the score by comparing number of legal moves for both players.

This and the next two strategies were observed while actually playing the game with human opponent.

Heuristic_3

Score is calculated as a difference in number of player's legal moves corrected for the distance from the board center. Distance is calculated as square root of the sum of squared distances in rows and columns.

It is presumed that the player closer to the center has more chances to win the game.

Heuristic_4

Score is calculated as a difference in number of player's legal moves corrected for the number of mutual legal moves and distance from the center of the board. This should promote taking one of the mutual moves in order to decrease available moves for the opponent and playing closer to the center.

Comparison

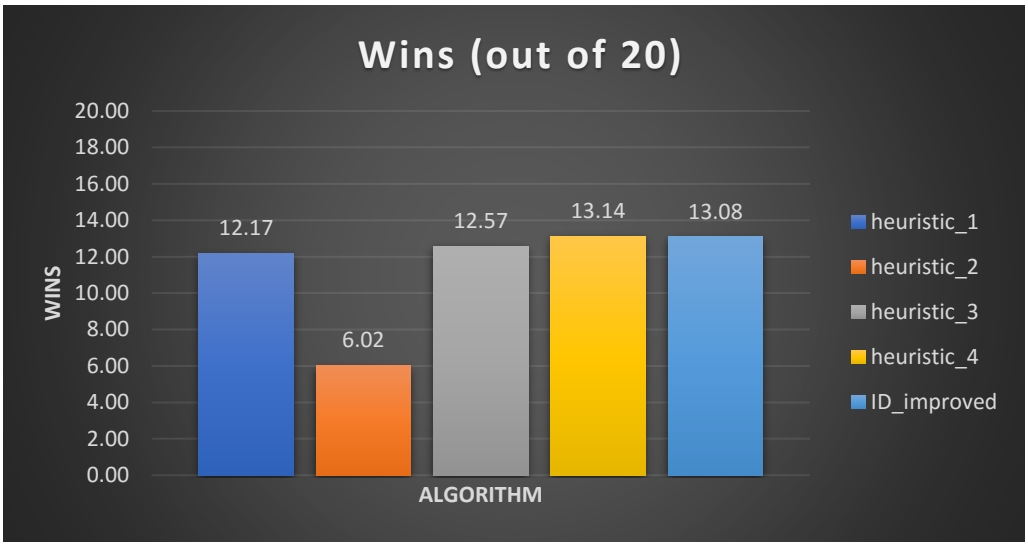
I modified tournament.py script in order to play 20 rounds per heuristics and to log results.

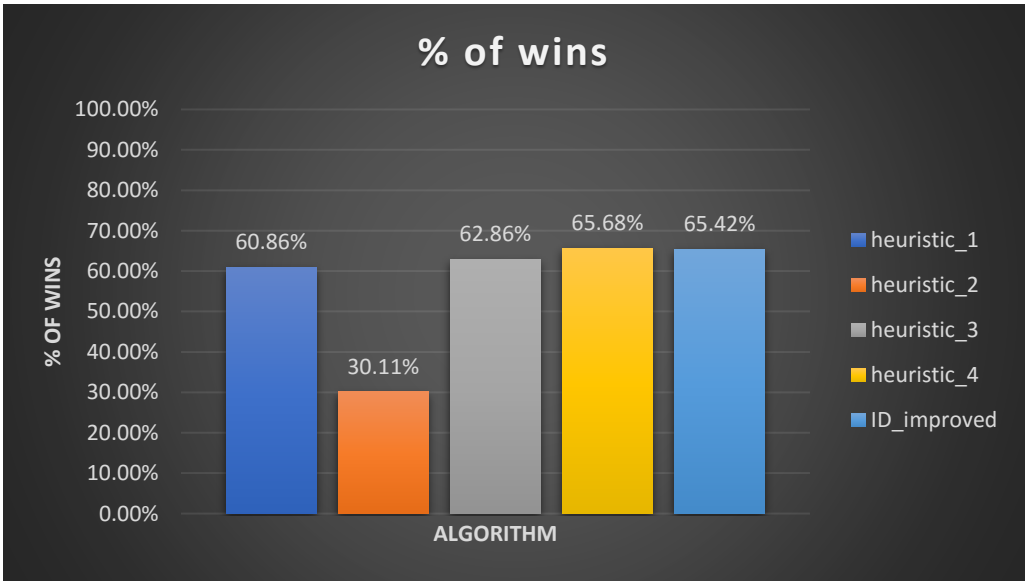
Then, I compared average results for each heuristic. Criteria that was used for choosing heuristics function were: percentage of wins compared to ID_Improved, execution speed and playability (can a strategy be applied by a human player).

Results are presented in the table below:

Game playing AI	heuristic_1	heuristic_2	heuristic_3	heuristic_4	ID_improved
execution time	5.17	2.64	4.45	4.82	n/a
avg. no. of wins (out of 20)	12.17	6.02	12.57	13.14	13.08
win percentage	60.86%	30.11%	62.86%	65.68%	65.42%
playability	1	5	5	5	n/a

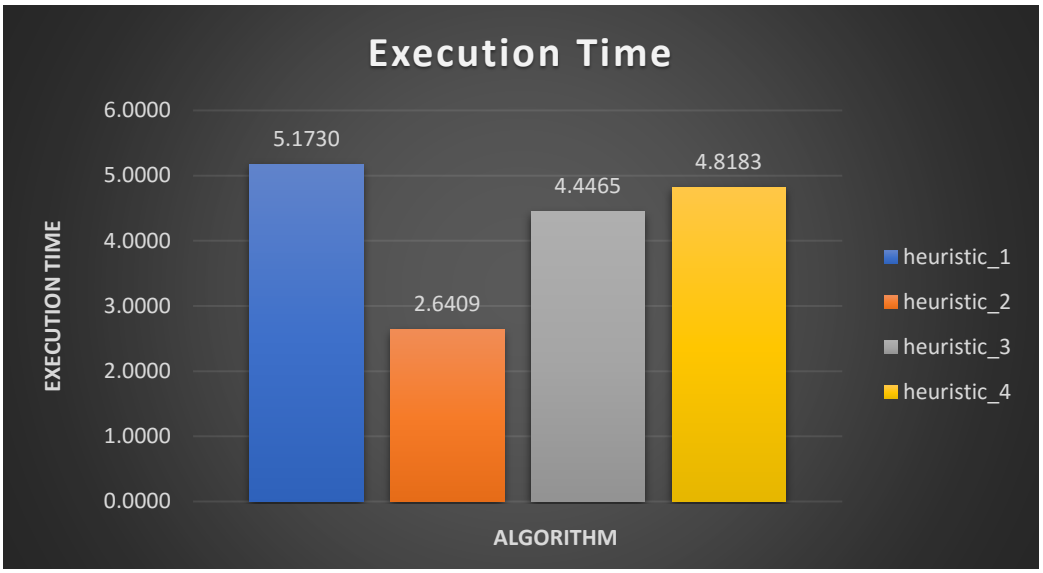
Criteria 1 – number/percentage of wins compared to ID_Improved:





Data shows that only heuristic_4 outperforms ID_Improved algorithm slightly, and based on this criterion, I would choose heuristic_4.

Criteria 2 – execution speed:



Based on this criterion, heuristic_2 is the fastest algorithm followed by heuristic_3. Since heuristic_2 is unusable due to really bad wins' percentage, based on this algorithm, I would choose heuristic_3.

Criteria 3 – playability:

Except heuristic_1, all other algorithms are easy to be performed by the human player. Based on this criterion, I will give heuristic_2, heuristic_3 and heuristic_4 the same score.

Taking into account all of the above, I would choose heuristic_4 since it is the only algorithm that consistently outperforms ID_Improved and is very easy to apply by human player. It is a bit slower than heuristic_3 but the difference is not significant.