For this assignment, the following heuristics were developed and tested.

Extended Search

This heuristic calculates the number of the positions that the current player can move to for upcoming and all future moves, and use that as the score. In theory, this heuristic should have more accuracy compared to ID-improve because it can better predict an endgame position. However, it performed worse than ID-improved when tested. Following profiling, we found that the heuristic's high cost resulted in a more shallow search tree, and thus is not as effective as ID_improved.

Delayed Extended Search

The second heuristic combined the effectiveness of the above algorithm with ID_improved's efficiency by delaying an extensive search until later in the game. In this heuristic, the number of moves 1-step-ahead is (the same as id_improved) is used until N steps has been taken (N is the board's width/height), then switch to the extended search method for the rest of the game. This optimisation resulted in a small improvement over ID_improved.

Different values (move number) of the changeover step were also tried. However, there was no significant improvement after change_over_step = N.

Knight's longest path

In this heuristic, instead of counting through all possible board position, we try to determine the number of moves that the current player can make as if they are the only player on the board. We use a "knight's tour" heuristic where the player always tries to move on the most restricted path. This heuristic is extremely fast and has the best improvement over ID_improved among ones examined here.

This heuristic is the chosen for the final submisisons. Previous 2 heuristics are available from the Git history for reference only (They were deleted in the final commit)

The submitted heuristic also use extensive search when partitioning is detected on the gameboard.

Testing result

For a more reliable result, I increased the number of matches between each pair of agents to 25. The

Heuristic	Win ratio (%)	Comment
ID_Improved	62	Benchmark sc
Extended Search	61.7	"real_steps_scores" in log
Delayed Extended Search	64.86	Change_over_step = N
	63.43	Change_over_step = 2N
	63.57	Change_over_step = 3N
	65.14	Change_over_step = 4N
Knight's longest path	68.29 (best)	Chosen heuristic

https://gist.github.com/thoaionline/b88bd67bdb7f655051cb9cc854ae1c03

https://gist.github.com/thoaionline/54f546e1f44162604cd245e8efce6c2d