

This report describes the performance of the game-playing agents using different heuristic functions and searching methods. The names of the agents are listed below in the table. For example, MM_Open means the agent uses minimax with fixed search depth equals 3 and the heuristic value is the number of moves open. The numbers in the table represent the number of matches ID_Improved or Student wins out of 400 total matches.

		Student			
	ID_Improved	Heuristic 1	Heuristic 2	Heuristic 3	Average
Random	295	295	314	314	305
MM_Null	246	272	290	279	272
MM_Open	188	200	210	248	212
MM_Improved	184	186	198	237	201
AB_Null	245	255	269	295	266
AB_Open	206	202	217	239	216
AB_Improved	215	215	242	252	231
Average win ratio	56.39%	58.04%	61.14%	66.57%	

MM: minimax with fixed search depth equals 3

AB: alphabeta pruning with search depth equals 5

ID_Improved: alphabeta pruning with iterative search

Student: alphabeta pruning with iterative search using one of the three original heuristics below

Heuristic 1: Number of moves I can make minus two times the number of moves opponent can make.

Heuristic 2: Sum of the values of all my legal moves – Sum of the values of all opponent's legal moves, where the value of a position is the number of legal moves from this position.

Heuristic 3: Number of empty spaces in reachable area around me minus number of empty spaces in reachable area around opponent moves.

The results of average win ration show that on average ID_Improved beats the other seven testing agents with a win ratio of 56.39%. The improved heuristic it is fast and enables a deeper search but it only provides a rough approximation of the "goodness" of a board. All three student agents outperform ID_Improved. And among them, the best performing student heuristic is Heuristic 3. This is much better heuristic than the improved heuristic with an average win ration of 66.57% against the testing agents. Heuristic 3 is the most expensive one which decreases the search depth of iterative search within fixed response time yet it still scores the highest win ratio.

From the last column in the table above, we can also see that Random is the worst player. And agents using alphabeta pruning don't outperform agents using only minimax.