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Heuristics Evaluation
AIND – Advanced Game Playing

Sticking to the center while keeping the opponent close (*custom score*) is just as good or better than the provided heuristic known as *improved score* in the game Isolation. To evaluate heuristic performance, a repeated trial of ten thousand (10,000) games was used in addition to the provided agent test *tournament.py*.

Custom score won 54.62% to 45.38% of the ten thousand random games against *improved score*. Tournament.py returned a result 64.29% with a baseline of 55.17% in favor of *custom score*.

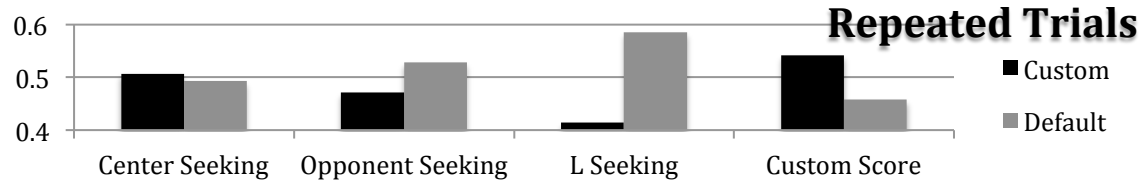
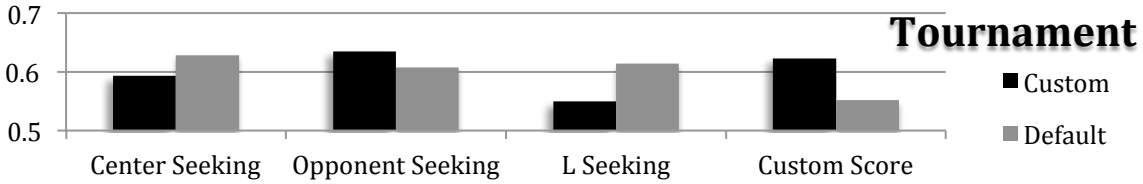


TABLE				
Heuristic	**Tournament**		**Trials**	
	Student	Baseline		
Center seeking	59.29%	62.85%	50.70%	49.30%
Opponent seeking	63.47%	60.71%	47.10%	52.90%
L Seeking	55.00%	61.43%	41.40%	58.60%
Custom Score	64.29%	55.17%	54.62%	45.38%

Three heuristics were made: sticking to the center, keeping the opponent close, and favoring positions that form a L-shape with the opponent.



Sticking to the center intuitively gives the player more room to move as opposed to being in a corner. A one thousand (1,000) trial game versus *improved score* resulted in 50.70% to 49.30% and a tournament result of 59.29% with a baseline of 62.85% shows no significant better performance. Since the trial games have a much higher sample size than the tournament, the tournament results are more variable.

Keeping the opponent close seeks to create an area of denial using the piece itself. A one thousand trial game was used resulting in 47.10% to *improved* score's 52.90%. Tournament results are 63.47% with a baseline of 60.71%. Again, indicating no significant performance improvement from the default.

Moving to positions that create an L-shape with the opponent at the other end denies the opponent an open position. It scored 41.40% to 58.60% in a one thousand trial game. A tournament resulted in 55.00% in a 61.43% baseline. The performance suggests the L heuristic is inferior.

The recommended evaluation function is a combination of center seeking and opponent seeking. The evaluation function is therefore:

$$f\,(\text{center\_seeking}(state) + \text{opponent\_seeking}(state))$$

where *state* is the current game state. The evaluation function is cheap on computation therefore it searches deeper and faster.

Reason 1.

Centering keeps it in an open space while opponent seeking creates a trail of denial as it orbits the opponent. This is a different perspective on the same concept of maximizing open moves and minimizing opponent moves heuristic, thus why it performs as well, individually, on tournaments 59.29% and 63.47% respectively with about a 60% baseline.

Reason2.

Putting the two together yields a sum greater than its aprts. Separately, performance is moderate with an almost 50/50 and 47/53 1k trial performance, and a 59%/63% tournament with a variable 60% baseline, respectively. Combined, performance increases with a 64% to 55% tournament and a ten thousand trial result of 54.62% win (318 million nodes visited with an effective branching factor of 1.945 at an average depth of 15.5); this strongly suggests a heuristic better than *improved score*.

Reason 3.

The center seeking uses a fast table lookup with low overhead. Low resource penalty when executed many times during a node visit. An average of 30,000 nodes is visited during a game, evidence of searching faster and deeper.

Reason 4.

Opponent seeking is a straight-line distance computation. Low resource penalty when called many times during node visit. With that 30,000 node average, along with the center seeking table lookup, it allows faster and deeper search.