Isolation Game Heuristic Analysis

1. Overview

The project aim to implement agent to play game of 'Isolation' using adversarial search. The game is two players deterministic game where in version the player moves restrict to '**L-Shape**'.

The aim of this document is to analyse the chosen heuristics and make recommendation based on there performance in the tournament.

2. Heuristics

The aim of three chosen heuristics is to penalise the moves which maximise opponent moves. More details in the below section.

2.1 custom_score Heuristic

This heuristic penalise the moves which maximise opponent by using below equation to compute the score. The amount penalties increase as the game progress and number of available block decrease.

$$Number\ of\ player\ avaliable\ moves\ -\ weight\ *\ Number\ of\ opponent\ avaliable\ moves$$

Where $Weight\ =\ 1\ -\ \frac{Number\ of\ free\ block}{Total\ number\ of\ blocks}$

2.2 custom_score_2 Heuristic

This heuristic use fix amount of penalties which chosen empirically instead using value which increase overtime, as showing in the below equation.

$$Number\ of\ player\ avaliable\ moves\ -\ \alpha\ *\ Number\ of\ opponent\ avaliable\ moves$$

Where α could be any real values and in my cause used 2.

2.3 custom_score_3 Heuristic

This heuristic apply the penalty by using the ratio between number of available player moves and number of available opponent moves and showing below.

$$\frac{Number\ of\ player\ avaliable\ moves}{Number\ of\ opponent\ avaliable\ moves\ +\epsilon}$$

Where ϵ is small amount added to 'Number of opponent available moves' to avoid dividing by zero.

3. Evaluating Heuristics

The heuristics were evaluating using tournament script, by running 10 matches against the following pre-defined heuristics:

- **Random**: Represent player which chose move randomly regardless of the score.
- **Open**: Represent player with heuristic which penalise moves that minimise player moves.
- **Centre**: Represent player with heuristic which penalise moves which takes player away from the centre.
- **Improved**: Represent player with heuristic which penalise moves which maximise opponent moves.

Below table shows the result from playing with above players where MM indicate MinMax with fixed depth, and (AB) indicates Alpha beta pruning, which highlight the following:

- AB players outperforms MM players because they can search deeper then MM players since they don't have depth restriction.
- AB custom performance only improved letter bit comparing with 'AB Improved', could be because the AB Custom heuristic consider the available free space before dismissing move because of number of available moves to the opponent.
- AB custom 2 seems to strangle in the some of the games where in some case ratio was 4/6, that could be result of the have penalty which most likely forcing the player to dismiss moves which could be valid.
- AB Custom 3 seems to match AB Approved most of the time.Thats because talking the ratio or difference between number of player available moves and opponents will yield the same result, where moves with higher number of available opponent moves end up with lower score.

	AB Improved	AB Custom	AB Custom 2	AB Custom 3
Random	10/0	9/1	9/1	9/1
MM Open	7/3	8/2	7/3	9/1
MM Center	9/1	10/0	8/2	9/1
MM Improved	8/2	9/1	8/2	10/0
AB Open	5/5	5/5	4/6	4/6
AB Center	6/4	7/3	4/6	5/5
AB Improved	5/5	6/4	6/4	5/5
	71.4%	**77.1%**	**67.1%**	**71.4%**

Ha

4. Recommandation

It seems from the above result Custom_score heuristic would be better choice, because the following reasons:

1. Had 77.1% win rate which is higher the other heuristics
2. Outperform “AB Improved” heuristic in most of the time.
3. Dynamic penalties which consider space available most likely make the heuristic consider more moves.