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Heuristic Analysis

So,what is a **Heuristic function**?

Heuristic function generally called as a **Heuristic** is a function that ranks alternatives in search algorithms at each branching step based on available information to decide which branch to follow.

We use these functions because sometimes we cannot bruteforce entire game to the end we are playing, so we just stop at a level of game where we timeout and then evaluate every state of game at that level and which ever state gets a maximum value for our heuristic we go for it.

In this project i have used 3 different heuristic functions.Those are listed below.

Heuristic Function 1 : Where do i have more moves.

Score = number of my moves

My first heuristic function choose a move in such a way that it has more moves after that move it has chosen.Having more moves is a good thing.So,i thought this would be a good heuristic.

The winning percentage was about 60% which was pretty bad.May be its bad to just consider our player moves and not considering opponent moves at all.Lets consider our opponent moves as well in the next heuristic function.

Heuristic Function 2 : An aggressive agent

Score = number of my moves - 1.5 * number of opponent moves

So,in the last heuristic we considered only our player moves which gave us a bad result.So,now i wanted to use my opponent moves in my heuristic as well.

The above equation is my heuristic function.Agent with this heuristic checks if it has more moves than the opponent moves which is good.Here we are not only looking at our moves but we are making sure that we have more moves compared to our opponent. Also,i used a weight of 1.5 for the second term in the equation to make my agent aggressive so that it goes after the opponent.

The winning percentage for this agent was 72.9% which is good compared to our last agent.Also,this agent out performed **AB_Improved** with a great margin.

Heuristic Function 3: How far am i from center.

Score = Distance from the centre

Now i wanted to try a little different.I want to make sure that player is always near to centre so that he may not get stuck.May be thats a good idea or it may be not.

The winning percentage was very very poor here.It was only 10%.So,clearly this is a very bad heuristic.May be its a bad idea to just near to the centre without considering where our opponent is.

Match #	Opponent	AB_Improved		AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost	Won	Lost
1	Random	7	3	10	0	9	1	2	8
2	MM_Open	6	4	6	4	8	2	0	10
3	MM_Center	8	2	8	2	9	1	1	9
4	MM_Improved	7	3	5	5	8	2	0	10
5	AB_Open	5	5	5	5	6	4	2	8
6	AB_Center	5	5	5	5	7	3	1	9
7	AB_Improved	5	5	3	7	4	6	1	9
	Win Rate:	61.4%		60.0%		72.9%		10.0%	

In the above table we can see the performance of my three agents.AB_Custom refers to the first heuristic while AB_Custom_2 refers to second heuristic and AB_Custom_3 refers to the third heuristic.

So,after looking at the above results i observed that a heuristic would make no sense or less sense if we don't consider our opponent at all.So,next time when i make a heuristic i will always consider my opponent as well.Also,i will try to see if a more aggressive agent give more better results.

For now, agent with second heuristic performed well.It was pretty aggressive too.

My Recommendation : So,i recommend to use the agent with below heuristic function because

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Score = number of my moves -  1.5 * number of opponent moves
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1. It makes sure that it has more moves compared to opponent moves.
2. As the agent is little aggressive it can overcome some side effects in game like horizon effect.
3. Also its aggressiveness helps it to go after the opponent and reduce its moves to some good extent besides it maintains the right balance between its moves and aggressiveness.
4. Also our agent winning percentage against different agents as you can see from the table above is about 74.3% which is good.Not only that it is the best agent of all three agents in the above table.