Heuristic Analysis
Masa Watanabe

The sample_players code provided a great example of a heuristic function which evaluated a non-terminal game state. As the objective of the game is to render the opponent immobile, the difference in the legal moves for the player and opponent player provided a good estimate. Strategically, a position on the board closer to the center made most sense as it was less likely to be restricted by the board's boundaries. Hence, the evaluation of the player's distance from the board led to more wins for the agent.

The heuristic function I chose was a combination of the two in the sample code. The idea was to assign a value to each legal position based on the distance from the center and sum it up to one value. Unlike the sample code which set the corner and center positions to be the same value, my function said the center position was a more appealing position to be than the corner.

The first heuristic took the small step of evaluating the current positions value based on the distance from the center. This function was essentially the same as the sample code. Two functions were created: one to get the center position and the other to get the value of the position. When the center position included two or more positions (which occurred when the width or height was even), the average of the two positions was taken. The second function took what was created in the first function and made it so that it could be applied not to a single position but a list of positions. This allowed me to pass the list of legal moves for the agent and get an aggregated, more forward-looking score. The third function improved upon the second function and calculated the difference of the two players aggregated scores. This required minimal change once the functions were set up to accept lists rather than a single tuple.

Although not consistently, at least one of the heuristic functions performed better than the AB_Improved agent in each iteration. The lack of improvement among the agents shows that the trade off for traversing an extra layer and involvement of both players for efficiency and slowness is not paying off. Although the position closer to the center of the board is an advantage when all positions are still available, the function does not consider that it isn't necessarily an advantage once more positions have been occupied. My suggestion would be to use the first agent. This is essentially evaluating the player's distance from the center, exactly like the sample function provided in the project. Although we see improvement in the above data set, after several iterations, the degree of improvement was inconsistent and in many scenarios not existent.

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Opponent	AB_Improved		AB_Custom		AB_Custom_2		AB_Custom_3	
	Won	Lost	Won	Lost	Won	Lost	Won	Lost
Random	494	506	492	508	485	515	499	501
MM_Open	1000	0	1000	0	1000	0	1000	0
MM_Center	1000	0	1000	0	1000	0	1000	0
MM_Improved	1000	0	1000	0	1000	0	1000	0
AB_Open	504	496	473	527	482	518	487	513
AB_Center	508	504	516	484	500	500	514	486
AB_Improved	496	504	512	488	467	533	498	502
Win Rate	71.5%		71.3%		70.5%		71.4%	

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