Heuristic Analysis:

The objective of this project build game agent to play the game “isolation”, This project incorporating the minimax algorithm for determining the optimal moves, alpha-beta pruning for seeks to decrease the number of nodes and iterative deepening search for time constraints and also implemented evaluation functions.

For this project successfully implemented minimax, alpha-beta, and iterative deepening algorithm and tested with test cases.

Custom score evaluation functions developed for fixed time limit each turn to search for the best move and respond, because restricting depth due to time constraint.

Three evaluation functions were implemented and also provided null_score, open_move_score and improved_score functions.

I developed custom score functions beat base line functions, based on changing weights between my moves vs opponent moves. But result is varying each run due to time constraints.

Custom Score Heuristic (Weighted Heuristic Score): This function weightage changed based on player center location. If player is center then play aggressive mode. If opponent player is center then play defensive mode, other cases less defensive mode.

Custom Score Heuristic 2 (Weighted Heuristic Score 2): This function subtracting between the player moves and opponent player moves and added weightage for my player playing aggressive mode.

Custom Score Heuristic 3 (Weighted Heuristic Score 3): This function weightage changed based on player moves. If player have more moves then play aggressive mode. If opponent player have more moves then play defensive mode.

Here tournament results:
This script evaluates the performance of the custom score evaluation function against a baseline agent using alpha-beta search and iterative deepening (ID) called `AB_Improved`. The three `AB_Custom` agents use ID and alpha-beta search with the custom_score functions defined in game_agent.py.

```
                        **************************
                             Playing Matches
                        **************************

Match  Opponent AB_Improved   AB_Custom  AB_Custom_2  AB_Custom_3
                Won | Lost   Won | Lost   Won | Lost   Won | Lost
  1 Random       10  |   0    10  |   0    10  |   0    10  |   0
  2 MM_Open       7  |   3     8  |   2     6  |   4     4  |   6
```

```
3   MM_Center      7  |   3    10  |   0     9  |   1     8  |   2
4  MM_Improved     4  |   6     4  |   6     4  |   6     4  |   6
5    AB_Open       3  |   7     3  |   7     4  |   6     6  |   4
6   AB_Center      8  |   2     9  |   1     9  |   1     7  |   3
7  AB_Improved     4  |   6     6  |   4     5  |   5     6  |   4
-------------------------------------------------------------------
     Win Rate:      61.4%        71.4%        67.1%        64.3%
```

Results:

Based on results I recommended “Custom Score Heuristic”. Here supporting reasons.

1) Custom Score Heuristic function performs compare to all other evaluation functions based on scores.
2) Actual quantitative evidence supporting the choice of Custom Score Heuristic function evaluates the state of the player. In two player game, we need to know state of the board relative to the opponent’s state, based that it taking decisions. This function dynamically act aggressive or defensive mode based on the opponent location. It is evaluate deeper then Custom Score Heuristic 2 function. Because it is knows who is occupied center location based on it is taking decisions. Custom Score Heuristic 2 functions evaluate regardless of location, because of that it is not able to evaluate deeper.
3) Custom Score Heuristic easier to implement and less inexpensive operations.

Conclusion

Based on test results here recommendations

1) Opponent is in center location my player need to play defensive mode.
2) Opponent is playing better then my player. For this scenario, evaluation function need to determine the location, if open area my player play aggressive mode or different weightage strategies for defeating opponent player.
3) Heuristic 3 functions win in open area scenario, because my player play aggressive mode if my player have more moves other wise defensive mode.