Activity 3: Heuristic Analysis Report

Heuristic Algorithm Pseudocode

The custom heuristic code is defined at *wid170047_score* in file *game_agent.py*. The explanation of the pseudocode is as follow:

1. If the current player loses the game in this state, return negative infinity. Else if the current player wins the game in this state, return positive infinity.
2. During the early game stages, move towards center of map where more free spaces is available. States where the position of current player nearer to the boundary map will have lower value.

$$H(t) = (p - o) - k\,(d)$$

   where *p* is the number of player moves, *o* is the number of opponent moves, *k* is a tuneable variable and *d* is the distance from the center
3. During the mid game stages, the player tries to be more aggressive by attempting to reduce opponents possible moves, heuristic function in this case is taken from *weighted_chances_heuristics.*
4. Finally, during the late game stages, the player tries to be more defensive by maximizing self possible moves, heuristic function in this case is taken from *weighted_chances_heuristics*.

Tournament Results

This script evaluates the performance of the custom heuristic function by comparing the strength of an agent using iterative deepening (ID) search with alpha-beta pruning against the strength rating of agents using other heuristic functions. The `ID_Improved` agent provides a baseline by measuring the performance of a basic agent using Iterative Deepening and the "improved" heuristic (from lecture) on your hardware. The `Student` agent then measures the performance of Iterative Deepening and the custom heuristic against the same opponents.

```
***********************
 Evaluating: ID_Improved
***********************

Playing Matches:
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```

Match 1: ID_Improved vs Random	Result: 1724 to 276	
Match 2: ID_Improved vs MM_Null	Result: 1395 to 605	
Match 3: ID_Improved vs MM_Open	Result: 1012 to 988	
Match 4: ID_Improved vs MM_Improved	Result: 952 to 1048	

Match 5: ID_Improved vs   AB_Null   Result: 1297 to 703
Match 6: ID_Improved vs   AB_Open   Result: 1150 to 850
Match 7: ID_Improved vs AB_Improved   Result: 1142 to 858

Results:

ID_Improved   61.94%

****
 Evaluating: Student1
****

Playing Matches:

 Match 1: Student1 vs   Random   Result: 1736 to 264
 Match 2: Student1 vs   MM_Null   Result: 1458 to 542
 Match 3: Student1 vs   MM_Open   Result: 1136 to 864
 Match 4: Student1 vs MM_Improved   Result: 1036 to 964
 Match 5: Student1 vs   AB_Null   Result: 1411 to 589
 Match 6: Student1 vs   AB_Open   Result: 1230 to 770
 Match 7: Student1 vs AB_Improved   Result: 1218 to 782

Results:

Student1   65.89%

****
 Evaluating: Student2
****

Playing Matches:

 Match 1: Student2 vs   Random   Result: 1745 to 255
 Match 2: Student2 vs   MM_Null   Result: 1433 to 567
 Match 3: Student2 vs   MM_Open   Result: 1106 to 894
 Match 4: Student2 vs MM_Improved   Result: 1041 to 959
 Match 5: Student2 vs   AB_Null   Result: 1388 to 612
 Match 6: Student2 vs   AB_Open   Result: 1235 to 765
 Match 7: Student2 vs AB_Improved   Result: 1209 to 791

Results:

Student2   65.41%

```
**********************
 Evaluating: Student3
**********************

Playing Matches:
----------
  Match 1:  Student3  vs   Random     Result: 1724 to 276
  Match 2:  Student3  vs   MM_Null   Result: 1412 to 588
  Match 3:  Student3  vs   MM_Open         Result: 1092 to 908
  Match 4:  Student3   vs MM_Improved      Result: 1018 to 982
  Match 5:  Student3  vs   AB_Null     Result: 1336 to 664
  Match 6:  Student3  vs   AB_Open   Result: 1210 to 790
  Match 7:  Student3   vs AB_Improved       Result: 1197 to 803


Results:
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Student3          64.21%

**********************
 Evaluating: Student4
**********************

Playing Matches:
----------
  Match 1:  Student4  vs   Random     Result: 1726 to 274
  Match 2:  Student4  vs   MM_Null   Result: 1392 to 608
  Match 3:  Student4  vs   MM_Open         Result: 1098 to 902
  Match 4:  Student4   vs MM_Improved      Result: 986 to 1014
  Match 5:  Student4  vs   AB_Null     Result: 1317 to 683
  Match 6:  Student4  vs   AB_Open   Result: 1178 to 822
  Match 7:  Student4   vs AB_Improved       Result: 1195 to 805


Results:
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Student4          63.51%

**********************
 Evaluating: Student5
**********************

Playing Matches:
----------
  Match 1:  Student5  vs   Random     Result: 1719 to 281
  Match 2:  Student5  vs   MM_Null   Result: 1439 to 561
  Match 3:  Student5  vs   MM_Open         Result: 1088 to 912
```

Match 4: Student5 vs MM_Improved   Result: 998 to 1002
Match 5: Student5 vs AB_Null   Result: 1354 to 646
Match 6: Student5 vs AB_Open Result: 1222 to 778
Match 7: Student5 vs AB_Improved   Result: 1207 to 793

Results:

Student5   64.48%

****
 Evaluating: Student6
****

Playing Matches:

 Match 1: Student6 vs Random   Result: 1741 to 259
 Match 2: Student6 vs MM_Null Result: 1520 to 480
 Match 3: Student6 vs MM_Open   Result: 1112 to 888
 Match 4: Student6 vs MM_Improved   Result: 1059 to 941
 Match 5: Student6 vs AB_Null   Result: 1418 to 582
 Match 6: Student6 vs AB_Open Result: 1245 to 755
 Match 7: Student6 vs AB_Improved   Result: 1209 to 791

Results:

Student6   66.46%

****
 Evaluating: Student7
****

Playing Matches:

 Match 1: Student7 vs Random   Result: 1714 to 286
 Match 2: Student7 vs MM_Null Result: 1435 to 565
 Match 3: Student7 vs MM_Open   Result: 1138 to 862
 Match 4: Student7 vs MM_Improved   Result: 1084 to 916
 Match 5: Student7 vs AB_Null   Result: 1369 to 631
 Match 6: Student7 vs AB_Open Result: 1199 to 801
 Match 7: Student7 vs AB_Improved   Result: 1224 to 776

Results:

Student7   65.45%

```
***********************
  Evaluating: WID170047
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Playing Matches:
----------
  Match 1:  WID170047  vs   Random        Result: 1751 to 249
  Match 2:  WID170047  vs   MM_Null       Result: 1482 to 518
  Match 3:  WID170047  vs   MM_Open       Result: 1115 to 885
  Match 4:  WID170047  vs  MM_Improved    Result: 1066 to 934
  Match 5:  WID170047  vs   AB_Null       Result: 1403 to 597
  Match 6:  WID170047  vs   AB_Open       Result: 1230 to 770
  Match 7:  WID170047  vs  AB_Improved    Result: 1266 to 734


Results:
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WID170047        66.52%
```

References

Aguilar Jimenez, J.C. (2018, January 9). *COMP6231: Search Heuristics for Isolation*.
http://ajulio.com/assets/documents/Adversarial_Game.pdf

Becker, K. (2020, April 3). *Analysis of Game Playing Heuristics for Isolation*. RPubs.
https://www.rpubs.com/primaryobjects/isolation