HEURISTIC ANALYSIS

For an Adversarial Game Playing Agent for Isolation

Submitted by

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as part of WID3009: Artificial Intelligence Game Programming

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SYNOPSIS

Isolation is a deterministic, two-player game of perfect information in which the players alternate turns moving a single piece from one cell to another on a board. Whenever either player occupies a cell, that cell becomes blocked for the remainder of the game. The first player with no remaining legal moves loses, and the opponent is declared the winner.

The aim of this project is to develop an adversarial search agent to play the game "Isolation". This project report focuses on the heuristics to be used in A* Search for minimax and alpha-beta pruning.

CUSTOM HEURISTICS

Modifying the code in the 'game_agent.py' file, specifically the 'custom_score()' function.

The Code for the heuristics is as follows:

```
if game.is_loser(player):
return float('-inf')
     if
game.is_winner(player):
return float('inf')
     my_moves =
game.get_legal_moves(player)
    opp_moves =
game.get_legal_moves(game.get_opponent(player))     my_moves_n
= len(my_moves)     opp_moves_n = len(opp_moves)
     w, h = game.width / 2., game.height /
2.     y, x =
game.get_player_location(player)
    # While considering available moves, try to stay towards the middle.
    return float(my_moves_n - opp_moves_n) - float(math.sqrt((h - y)**2 + (w - x)*
*2))*0.25
```

This custom heuristic implementation is run under the agent name of
"WID170711 Implementation"

PERFORMANCE

The performance depends on the hardware, as faster hardware can search deeper in a short amount of time. So, when run another time, run a different time, or run on different hardware, the evaluation score can change.

Three sets of experiments have been conducted: standalone, against standard opponents, and against the custom heuristics from the rest of my teammates

Against Standard Opponents

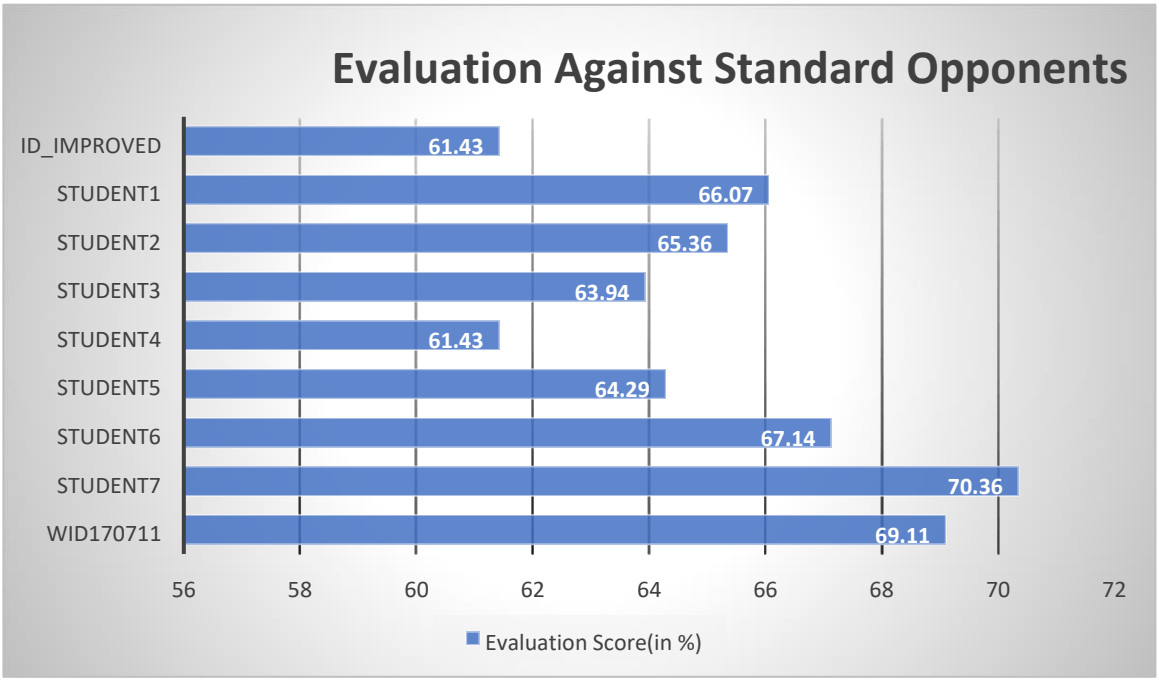
Here, we run the custom heuristics along with other heuristic components already provided in the project.

For faster evaluation (due to hardware constraints), the number of trials is set 10. The time limit remains the same, at 150 ms.

The heuristics and agent names used in this evaluation are:

Agent Name	Heuristic Function
ID_Improved	improved_score()
Studentl	aggressive_heuristic()
Student2	defensive_heuristic()
Student3	maximizing_win_chances_heuristic()
Student4	minimizing_losing_chances_heuristic()
Student5	chances_heuristic()
Student6	weighted_chances_heuristic()
Student7	weighted_chances_heuristic_2
WIDI 70711_lmplementation	custom_score()

The evaluation comparison between the afore mentioned agents and the custom heuristic discussed in this report is shown in this chart:



The raw evaluation of results can be found in Appendix A: Evaluation Against Standard Opponents

Against Teammates

Here, we run the custom heuristic implementation against my teammates' heuristic implementations.

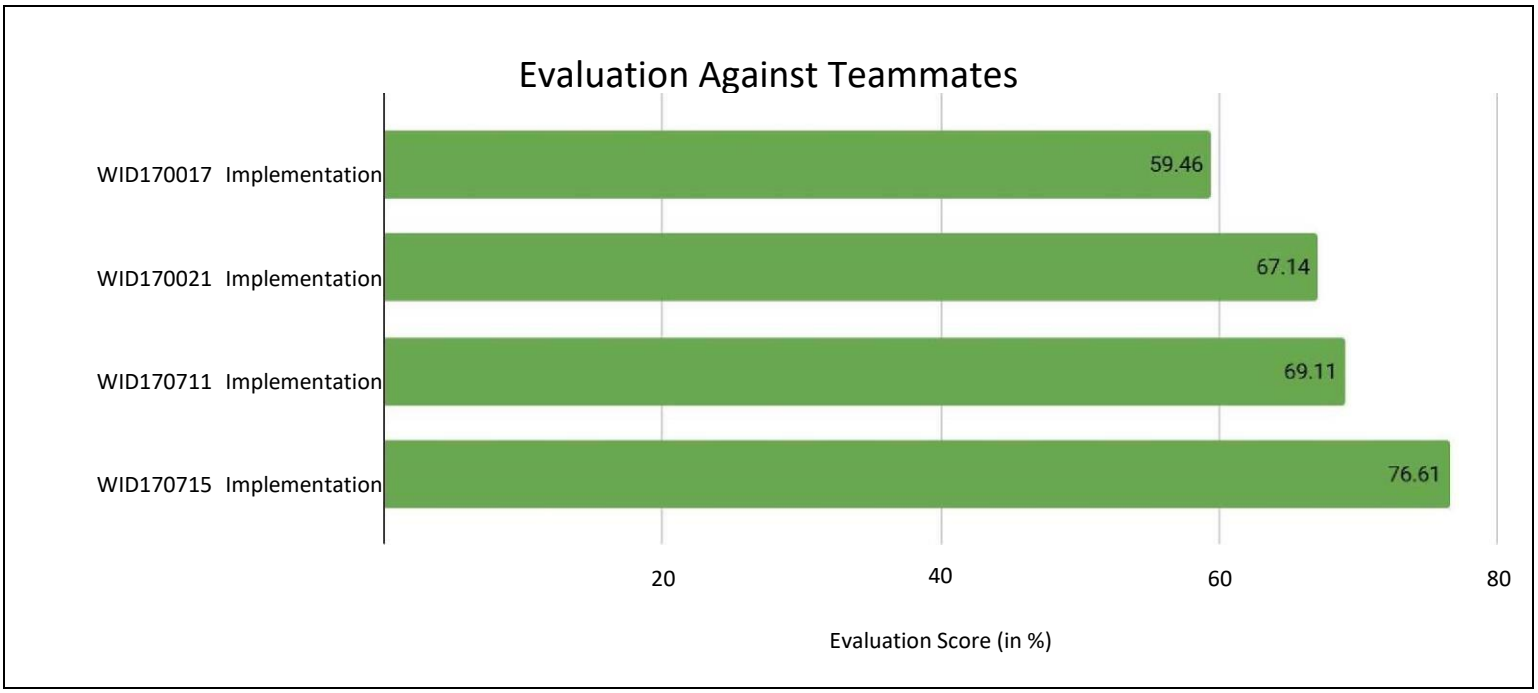
To minimize the number of variables affecting the performance. The number of trials is 20, and the time limit is 150 Ms.

The teammates and agent names are:

Matric Number	Name	Agent Name
17195727 | WID170017	Jasherr Ravindran	WID170017_Implementation
17107141 | WID170021	Kuganeswaran Letshimanan	WIDI 70021 _Implementation

17129042 | WID170711	Azraf Kabir	WIDI 70711 _Implementation
17069496 | WID170715	Govardhan Padmanabhan	WID170715 Implementation

The evaluation comparisons between the heuristics are shown in this chart:



The raw evaluation results can be found in Appendix B: Evaluation Against Teammates.

CONCLUSION

To evaluate the custom implementation. When run with the included standard opponent agents, at 10 matches, the custom implementation got a final score of 69.11%. When run along with the implementations of teammates, at 20 matches, the custom implementation got a score of 69.11%.

APPENDICES

APPENDIX A

Evaluation Against Standard Opponents

----------	WID170711 Implementation vs	Random	Result: 38 to 2
	WID170711_ Implementation vs	MM Null	Result: 37 to 3
Match 1:	WID170711_ Implementation vs	MM_Open	Result: 25 to 15
Match 2:	WID170711 Implementation vs MM_ Improved		Result: 26 to 14
Match 3:	WID170711_ Implementation vs	AB Null	Result: 32 to 8
Match 4:	WID170711_ Implementation vs	AB_Open	Result: 28 to 12
Match 5:	WID170711 Implementation vs AB_ Improved		Result: 28 to 12
Match 6:			
Match 7:			

Results:

WID170711_lmplementation 69.11%

APPENDIX B

Evaluation Against Teammates

Evaluating: WID170017_lmplementation

Playing Matches:

Match 1:	WID170017 Implementation vs	Random	Result: 65 to 15
Match 2:	WID170017_ Implementation vs	MM Null	Result: 59 to 21
Match 3:	WID170017 Implementation vs	MM_Open	Result: 42 to 38
Match 4:	WID170017 Implementation vs MM_ Improved		Result: 34 to 46

Match 5: WID170017_ Implementation vs AB Null Result: 50 to 30
Match 6: WID170017_ Implementation vs AB_Open Result: 46 to 34
Match 7: WID170017 Implementation vs AB_ Improved Result: 37 to 43

Results:

WID170017_lmplementation 59.46%

Evaluating: WID170021_lmplementation

Playing Matches:

Match 1: WID170021_ Implementation vs Random Result: 68 to 12
Match 2: WID170021 Implementation vs MM Null Result: 63 to 17
Match 3: WID170021 Implementation v s MM_Open Result: 49 to 31
Match 4: WID170021 Implementation vs MM_ Improved Result: 43 to 37
Match 5: WID170021 Implementation vs AB Null Result: 54 to 26
Match 6: WID170021_ Implementation vs AB_Open Result: 50 to 30
Match 7: WID170021_ Implementation vs AB_ Improved Result: 49 to 31

Results:
WID170021_lmplementation 67.14%

Evaluating: WID170711_lmplementation

Playing Matches:

Match 1: WID170711_ Implementation vs Random Result: 69 to 11
Match 2: WID170711_ Implementation vs MM Null Result: 60 to 20
Match 3: WID170711 Implementation vs MM_Open Result: 43 to 37
Match 4: WID170711 Implementation vs MM_ Improved Result: 45 to 35
Match 5: WID170711_ Implementation vs AB Null Result: 56 to 24
Match 6: WID170711_ Implementation vs AB_Open Result: 60 to 20

Match 7: WID170711 Implementation vs AB_ Improved Result: 54 to 26

Results:

WID170711_lmplementation 69.11%

Evaluating: WID170715_lmplementation

Playing Matches:

Match 1: WID170715_ Implementation vs Random Result: 76 to 4
Match 2: WID170715_ Implementation vs MM Null Result: 73 to 7
Match 3: WID170715_ Implementation vs MM_Open Result.• 50 to 30
Match 4: WID170715_ Implementation vs MM_ Improved Result: 43 to 37
Match 5: WID170715_ Implementation vs AB Null Result: 70 to 10
Match 6: WID170715 Implementation vs AB_Open Result: 61 to 19
Match 7: WID170715 Implementation vs AB_ Improved Result: 56 to 24

Results:

WID170715_lmplementation 76.61%