AI Homework 4

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Implementation:

For this assignment we implemented a minimax algorithm that simulates 2 players playing a connect 4 game with rules similar to tic-tac-toe. 2 players taking turns placing X's and O's on a 5x6 grid with the goal to get 4 in a row (horizontally, vertically, or diagonally). The only difference between the 2 players is their look ahead values. Player 1 (X's) had a look ahead value of 2 and player 2 (O's) had a look ahead value of 4. The minimax algorithm uses -1000 for loss, 0 for tie, or 1000 for win for the utility value and the following heuristic for not terminating nodes.

h(n) = 200*[number of two-side-open-3-in-a-row for me]

– 80*[number of two-side-open-3-in-a-row for opponent]

+ 150*[number of one-side-open-3-in-a-row for me]

– 40*[number of one-side-open-3-in-a-row for opponent]

+ 20*[number of two-side-open-2-in-a-row for me]

– 15*[number of two-side-open-2-in-a-row for opponent]

+ 5*[number of one-side-open-2-in-a-row for me]

The implementation uses 2 main classes

1. Class Board - The Board class is responsible for determining the heuristic for both players and is also responsible for determining the winner or tie, the current placeable spaces and has helpers methods for printing the board states.
2. Class Player - The player class contains attributes about each player and also is responsible for calling board methods such as *PlacePiece*. The player class also calls the MinimaxDecision function which is responsible for determining the best move.

Additionally a function *PlayGame* is responsible for placing the initial pieces and iteration between both players until the game is complete.

For additional information on classes, methods, and functions refer to additional comments in the code.

System Requirements

Language: Python 3.12

The following results were produced on a laptop with an “AMD Ryzen 7 4800HS with Raedon Graphics” CPU with 48 GB of RAM

Results:

Move list (Player, location placed at, cpu time taken, nodes generated) :

('x', (3, 4))

('o', (3, 3))

('x', (2, 3), 0.024186799999999998, 138)

('o', (4, 5), 6.6285806, 38553)

('x', (4, 3), 0.05200669999999974, 280)

('o', (2, 5), 15.818387, 88646)

('x', (3, 5), 0.06910979999999967, 374)

('o', (2, 4), 19.0367411, 101238)

('x', (4, 2), 0.06279199999999463, 302)

('o', (4, 4), 19.017023899999998, 102712)

('x', (2, 2), 0.05500200000000177, 330)

('o', (3, 2), 16.6880277, 94339)

('x', (1, 1), 0.06198050000000421, 324)

('o', (1, 3), 11.438075400000002, 61489)

('x', (1, 4), 0.05487349999999935, 256)

('o', (2, 1), 6.704293100000001, 35715)

('x', (3, 1), 0.037532200000001126, 196)

('o', (5, 1), 3.5220587000000023, 19045)

('x', (5, 2), 0.026543699999990622, 144)

('o', (5, 3), 1.5964388000000014, 9031)

('x', (5, 4), 0.016953000000000884, 100)

('o', (4, 1), 0.5872154999999992, 3609)

('x', (1, 2), 0.01139639999999531, 64)

('o', (1, 5), 0.1802962000000008, 1099)

('x', (5, 5), 0.0064264999999892325, 36)

('o', (1, 6), 0.0294983000000002, 205)

('x', (2, 6), 0.0022471000000052754, 16)

('o', (3, 6), 0.0018993999999992184, 15)

('x', (4, 6), 0.0005279000000086853, 4)

('o', (5, 6), 0.0001773999999983289, 1)

Total time: 101.7302912

X turns: 15, O turns: 15, Total turns 30

Match was a draw