AI Term Project

Spring 2023

1. Project objective:

Design an AI program to play a two-player 3×3 board game.

2. Language:

C++, Python

3. Game Rules:

a. At the beginning of the game, the 3x3 board is randomly filled with positive integers*, and the order of play is determined for the two players.

22	33	44
55	66	77
88	99	111

turn 0 (initial state)

b. On each turn, a player must choose a row or column that does not contain the number 0, and select a number between 1 and 3 to subtract from each of the integers in that row or column. This number represents the player's cost for that move. If the result after move is not met termination conditions*, play continues with the other player.

22	33	44
55	66	77
88	99	111

turn 0 (initial state)

22	33	44
55	66	77
88	99	111

turn 1, player A,
pick 1st row, -3

19	30	41
55	66	77
88	99	111

turn 2, player B,
pick 2nd column, -2

19	28	41
55	64	77
88	97	111

turn 3

c. There are restrictions on the numbers that can be subtracted.

If a row or column contains the number 1, the player can only subtract 1 from each number in that row or column.

22	33	44
55	66	1
88	99	111

22	33	43
55	66	0
88	99	110

turn N, player A,
pick 3rd column, -1
(-2, -3 are not allowed)

turn N+1

If a row or column contains the number 2 but not the number 1, the player can only subtract either 1 or 2 from each number in that row or column.

22	33	44
55	2	77
88	99	111

22	33	44
54	1	76
88	99	111

22	33	44
55	2	77
88	99	111

22	33	44
53	0	75
88	99	111

turn N, player A,
pick 2nd row, -1
(-3 are not allowed)

turn N+1

turn N, player A,
pick 2nd row, -2
(-3 are not allowed)

turn N+1

d. The game ends when one of two termination conditions is met:

Termination condition 1: If all the numbers in any row, column, or diagonal become 0, the game ends with a bonus cost reward* for the player who achieved this condition.

0	33	44
55	0	77
88	99	3

0	33	41
55	0	74
88	99	0

or

22	33	44
55	66	77
0	0	2

22	33	42
55	66	75
0	0	0

or

0	33	44
0	66	77
1	99	111

0	33	44
0	66	77
0	98	110

Termination condition 2: If every row or column contains the number 0, and termination condition 1 above is not happened, the game ends with a bonus cost penalty* for the player who achieved this condition.

0	33	44
55	66	0
88	3	111

0	33	44
55	66	0
85	0	108

e. The player with the lowest total cost at the end of the game is declared the winner.

f. There is time limit for each move, the limit is 60 seconds, for the player who exceeded time limit will lose this game.

g. *Further details about the game setting will be announced on e3 later.

4. What to turn in:

- A report of the search strategy of your own design (student_ID.pdf, e.g. 309554041.pdf).
- A copy of your source code (student_ID.xx, e.g. 309554041.py).
- Please zip all your files (student_ID.zip, e.g. 309554041.zip).
- Any violation of the file name format will incur 5 pts penalty deduction.

5. Grading policy:

- Coding (60%)
    - ◆ Tournament
        - You will be randomly grouped, and a double elimination tournament will be held.
        - The higher ranking, the more points.
        - You will get reasonable points for your project if you turn in what you are supposed to even though your AI program is not among the top-ranking programs in class.
        - To be fair, an incomplete project will incur a low grade.

- Report (40%)
    - ◆ Design philosophy (20%)
        - If your algorithm completely relies on randomness, you will get zero point.
        - Clearly describe your algorithm.
            - Search strategy
            - Heuristics (if there is any)
        - Discussion (20%)
            - Motivation behind your search strategy and heuristics
            - Challenges in implementation
            - Improvement by your methods
            - Any lesson learned from project
- NO CHEATING!! You will receive no credit if you are found cheating or plagiarism.