

# AI Term Project

Spring 2023

Due Date: 11:50 PM June 16, 2023

## 1. Project objective:

Design an AI program to play a two-player 3x3 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, 1, 2 or 3 to subtract from each of the integers in that row or column**. This number represents the cost of the player's move. If the resulting board does not meet any of the **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, player A,  
pick 3rd column, -1

19	28	40
55	64	76
88	97	110

turn 4

- 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

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

22	33	43
55	66	0
88	99	110

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

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

22	33	44
54	1	76
88	99	111

turn N+1

22	33	44
55	2	77
88	99	111

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

22	33	44
53	0	75
88	99	111

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 and the player who achieves this condition is **rewarded\*** with a bonus.

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 has not occurred**, the game ends and the player who achieves this condition is **penalized with an extra cost\***.

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 a **time limit of 60 seconds for each move**, and any player who exceeds the time limit will lose the game.

Note: \* 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.py, 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 the ranking, the more points you will receive.
- You will receive a reasonable number of points for your project if you turn in what you are supposed to, even if your AI program is not among the top-ranking programs in the 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

###### ■ Improvements achieved by your methods

###### ■ Any lesson learned from project

- **NO CHEATING!!** You will receive no credit if you are found cheating or plagiarism.