

ARTIFICIAL INTELLIGENCE

Ultimate Tic-Tac-Toe (4x4) A.I. Bot

Team INVICTUS

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Search Algorithm

- Min-Max algorithm with alpha-beta pruning with progressive deepening
- Min depth starting with 3 and goes up till depth 5-6 in middle game and upto 12 in end game
- Time limit: 14.5 sec
- Transposition Table for optimization

Heuristics

The board is the entire 16x16 game board. A block is a 4x4 subgrid. A cell is a single (1x1) cell.

Block Score

- Calculate number of rows, columns and diagonals that can be won by our bot
- Number of cells occupied in one row/ column/ diagonal is more than a higher score is given

If number of cells occupied are 1 then score=3

2 then score=9

3 then score=27

- If a block is won, score=100
- In a similar fashion, calculate the block score of the opponent

Board Score

- Multiplication of all individual block score in a line. This gives probability of winning in each row, column or diagonal.
- In a similar fashion, calculate the score of the opponent
- BoardScore = OurScore – OpponentScore

Behaviour

- The bot tries to play the game such that it has its own advantage in a few blocks while efficiently redirecting the opponent in different blocks such that it will not have an advantage.
- The occupied blocks are such that a winning position is achieved within a few moves.
- Then when opponent tries to make two or three in a line, the bot would pick up another favourable line on which it can capture the blocks to win. This is achieved since the bot has already taken a starting advantage.
- If the opponent is able to handle such behaviour and plays aggressive, the bot would play defensive and then try to get the winning line.
- To tweak the behaviour, we can adjust the parameters for block and board evaluation. If the block score parameters are set to 4, 16, 64 or 100 for one, two, three or four respectively in a line, then the bot plays aggressively. However, this results in draw when playing against highly defensive opponents. With others, it would still result in comfortable wins.

Game Statistics:

	Total	Win	Draw	Loss	Invalid Move
Pool Stage	16	14	2	0	0
Semi-final Stage	18	14	3	0	1
Final Stage	22	10	6	2	4