Grp 8-01

Contents

1.Introduction

1.1 Description

The aim of this project is to research, understand and find the most efficient methods and tricks to solve the different variants of tic-tac-toe.

1.2 Objectives and Research QLuestions

1.2.1 Objectives

The objectives of this project are as follows:

- To assist people to find the most effective ways to win tic-tac-toe.

- To use excel to calculate the percentages and winning rate for each method and trick.

1.2.2 Research Questions

1. Research and understand the solution to the original version of tic-tac-toe and the best methods and tricks to win or to force a draw on a bigger grid like a ‘4X4’ and a ‘5X5’.

2. Find the winning condition of the notakto version, does the first player have a definite chance of winning? Can this be prevented by using larger grids like a 4X4 and a 5X5?

3. Find the winning condition of the torus version, does the first player have a definite winning solution? Will it be better if it is played on a bigger grid like a 4X4 and a 5X5?

2. Literature Review

For our literature review, we will be quoting some basic strategies and points we have learnt from online sources.

- Taking control of the middle or corners of the grid.
- Strategically placing your move based on where your opponent placed his move before.
- If both players are playing with an optimal strategy, every game will end in a tie

3. Methodology and Study

3.1 Methodology

- Extensive playing of the game was carried out to explore winning conditions.
- Combinatorics was also applied to mathematically determine the winning position and losing position by each player.
- Used n x n formula to explore different winning conditions.

3.2 Results for RQ1

3.2.1 Results for 3x3 Normal Tic-Tac-Toe

- Even if you are not going first, you are able to force a draw no matter what happens.
- If your opponent puts his first move in a corner, put your move in the middle to force a draw.
- If your opponent puts his first move in the middle, put your move in a corner to force a draw.
- If your opponent puts his move at a side, put your move in the middle to force a draw.
- No matter where your opponent puts his/her move, you will definitely be able to force a draw and prevent him from winning.

Summary:

- If you put your first move on the corners, and if your opponent places his first move anywhere but the middle, you can use a strategy which is called the 'L' method which will allow you to win the game. That is why it is best to start first.
- Even if you don't start first, you can still force a draw by strategically placing your symbol accordingly to where your opponent places his first move.
- If you follow all the tips and tricks correctly, every game of 3x3 Tic-tac-Toe will end in a draw providing both players are playing optimally.

3.2.2 Results for 4x4 Normal Tic-Tac-Toe

- General approach: Control centre area and corners.
- Draw margin is high-with a bigger grid, more opportunities for players to block each other

- No firm and proper strategy to win

Summary:

- For 4x4, it's harder to win if you have to ensure a 4-in-a-row
- A draw margin is still very high as your opponent can block many of your moves
- Final Conclusion: No proper strategy to win 4x4 normal tic tac toe.

3.2.3 Results for 5x5 Normal Tic-Tac-Toe

- Basically, whatever tile your opponent puts his symbol on, you respond by putting your symbol on the tile with the corresponding line (refer to Figure 1). This way you will block any row that your opponent may be able to complete. There is no need to block anything if your opponent puts his tile in the middle. There is currently no strategy able to be used to win a game of 5x5 Tic-Tac-Toe because it is difficult to obtain a 5x5 with the opponent always blocking you throughout the game. Thus, it is impossible to have a proper and firm strategy to win this variation of Tic-Tac-Toe.

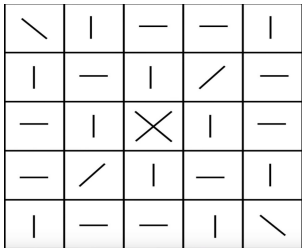

Figure 1

Summary:

- You will be able to force a draw on a 5x5 tic-tac-toe board by following the pairing strategy.
- A draw margin is very high because it is difficult to obtain a 5x5 with the opponent always blocking you throughout the game.
- Thus, it is difficult and almost impossible to have a proper and firm strategy to win this 5x5 variation of tic tac toe.

3.3 Results for RQ2

3.3.1 Results for 3x3 Notakto Tic-Tac-Toe

- If played on a 3x3 grid, the first player will win no matter what as long as he places his first symbol in the centre grid.
- This is because Player 1 will occupy every single possible row if he puts his move in the middle, meaning that Player 2 will create 2 symbols in a row no matter where he puts it, allowing Player 1 to complete a 3-in-a-row and winning the game.

Summary:

- First player will always win no matter the circumstances.

3.3.2 Results for 4x4 Notakto Tic-Tac-Toe

- For 4x4 Notakto Tic-Tac-Toe, as the board is now bigger, it provides a wider range of moves to choose from.
- However, if both players are playing optimally, then the second player will always win the game in 6-8 moves

Summary:

- Second player will win if both players are playing optimally.

3.3.3 Results for 5x5 Notakto Tic-Tac-Toe

- For 5x5 Notakto Tic-Tac-Toe, as the board is now even bigger, it provides an even wider range of moves to choose from.
- However, under optimal play, every game will end with Player 1 winning the game in 11-15 moves.
- After some research and testing, we found out that if there is an odd number of squares in the grid, Player 1 will always win.
- However, if there is an even number of squares in the grid, then Player 2 will always win.

Summary:

- When there is an odd number of squares, the first player will win, provided both players are playing optimally.
- When there is an even number of squares, the second player will win, provided both players are playing optimally.

3.4 Results for RQ3

3.4.1 Results for 3x3 Torus Tic-Tac-Toe

- An optimal game of 3x3 torus tic-tac-toe usually consists of exactly 7 moves:

➢ Player 1 places an X anywhere on the board (9 choices)
➢ Player 2 places an O anywhere on the board (8 choices)
➢ Player 1 places an X anywhere on the board (7 choices)
➢ Player 2's move may be forced (1 choice), if not, he places the O anywhere (6 choices)
➢ Player 1's move will be forced (1 choice)
➢ Player 2 is caught in a fork (Player 1 can win in two different ways), so Player 2 has to block Player 1 in one way (2 choices)
➢ Player 1 places the his last move and wins (1 choice)

Summary:

- Optimal games are when both players play the most strategically and uses the methods and tricks based .
- Usually, optimal games ends in a draw, but in this case, the first player will always win.
- There is a 100% chance of first player winning during an optimal game of 3x3 torus tic-tac-toe.

3.4.2 Results for 4x4 Torus Tic-Tac-Toe

- It seems that if you go first, you can always force a win. You could lose if you wanted to (while going 1st), but you can always win if you go first. And actually, you're destined never to have a tie game.
- There is no real strategy to win 4x4 torus, other than there is no way to include draw in the game. (As proven by our research and percentages)
- Some questions that we can ask ourselves…{Left unanswered due to inadequate info}
    - ➢ For each possible first move, how many essentially different second moves are there?
    - ➢ Is there an optimal position for the first marker? If so, where?

Summary:

- There is no definite winning strategy , but is most likely that if you go first, you will win.

3.4.3 Results for 5x5 Torus Tic-Tac-Toe

- Just like the 4x4, there is no firm way to win 5x5 torus tic tac toe.
- Going first might ensure you the win.

Summary:

- There is no definite winning strategy , but is most likely that if you go first, you will win.

4. Conclusion

Many methods can be used to ensure a win, but optimal playing, in some cases, may result in draws. Even though our goals were fulfilled, there is more potential in our project. With more time, we believe we can find new methods to solve each version with more efficient and easier tricks.

5. References

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