

## REPORT

Tic tac toe is a type of game for two players. It is generally played on 3\*3 grid. Its objective is for the player to form a horizontal, vertical or diagonal line of three consecutive symbols('X' or 'O').

A player wins if he gets success in placing his symbols in a row(horizontally, vertically or diagonally). If none of the players gets success in doing this, then the game draws. Humans can play this game against the computer also. For this we have done using two algorithms MiniMax and Reinforcement learning.

Minimax finds optimal moves for a player. It considers all the possible future outcomes of each move. This algorithm creates a decision tree so that it explores all possible moves. It uses backtracking to traverse. Tic Tac Toe is a zero-sum game i.e.  $\text{score}(\text{win of one player}) + \text{score}(\text{loss of other player}) = 0$ . In such games, the goal is to minimize the opponent's score.

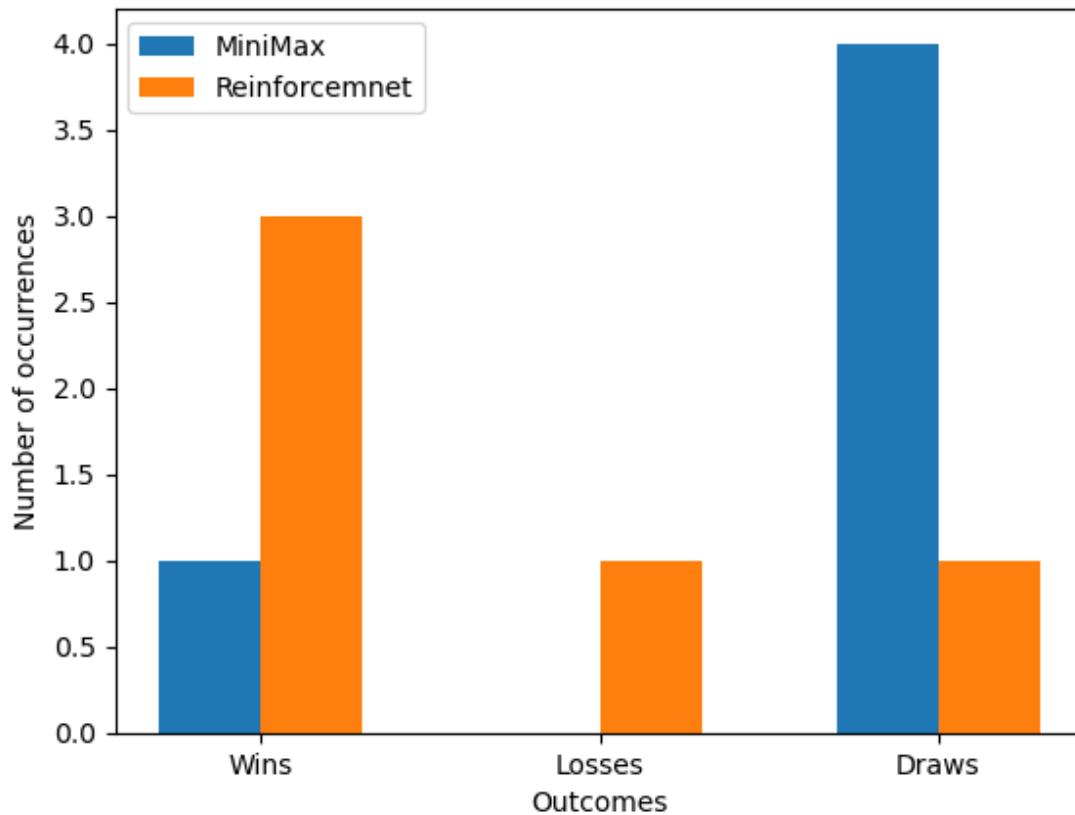
- Imagine we're playing Tic-Tac-Toe against someone super smart. The Minimax algorithm helps us make the best moves assuming our opponent is also super smart and always tries to win.
- We think about all the possible moves we can make and all the possible responses our opponent might have. We do this like a tree, thinking ahead to see what might happen.

Reinforcement learning trains a model to make decisions based on its action's reward.

- Now, imagine we're playing Tic-Tac-Toe, but this time, we're not assuming our opponent is super smart. Instead, we learn from your own experiences.
- We try different moves and see what works. If a move leads to a win, we remember it's a good move. If it leads to a loss, we remember it's not a great move. Over time, you get better by learning from my wins and losses.

## Analysis of the algorithms by graph:

Human vs Computer: Wins, Losses, and Draws (When computer play first)



Algorithms	Total No of playing	No. of win By human	No.of win by computer	No of draw	Remarks
MiniMax	12	0	5	7	The computer will win or (draw) if the MiniMax algorithm is used.
Reinforce ment	12	5	4	3	Computer can loss the game against human

Let's see detailed analysis: X : Human turn , O : computer turn  
1X means the first move is taken by a human.

**TABLE 1: Min-Max algorithm**

CASE 1 (DRAW)			CASE 2 (DRAW)			CASE 3 (LOSE)		
7X	4O	8O	7X	8O	4O	2O	1X	5X
6O	5X	9X	2O	1X	9X	3X	4O	
3X	1X	2O	3X	5X	6O			6O

I analyzed by my data that minmax will always try to minimize opponent score, and maximize its own. That's why humans are losing or the game is drawing. It states decision making i.e. always selecting the best possible move to win or at least draw the game.

**TABLE 2: Reinforcement Learning:**

CASE 1 (WIN)			CASE 2 (LOSE)			CASE 3(DRAW)		
1X	4O		1X		6O	1X	6O	7X
	5X			5X	2O	9X	3X	8O
2O		3X	3X		4O	2O	5X	4O

If humans play this game optimally, then humans win. I set the alpha value to 0.25. For saturation, I called the learning function 500 times. From these iterations it learned a good value. Since after these many iterations, values were not changing much as it became stable.so, i considered values as final values.

### Comparison between both:

So, overall minmax plays like genius. assuming that the opponent is genius, making decisions to maximize its own score and minimize the player's score. I think that it becomes more complex due to the exponential growth of our game tree. Also leads to high time complexity.And reinforcement learning plays by learning from its own experiences. It requires more iterations to converge.

### Learning for the assignment :

Earlier I tried to code by myself but I didn't succeed. I took the coding help from AI tools and I also asked my friends. I analyzed new things by this assignment after making a graph and comparing between both which I didn't get to know earlier just by reading.