

## Tic Tac Toe

### Can you always Win?

Tic-tac-toe, also known as noughts and crosses or Xs and Os, is a game for two players who take turns placing an X or an O in the the 9 spaces in a 3x3 grid. The player who succeeds in placing three of their marks in a horizontal, vertical, or diagonal row wins the game.

Players soon discover that the the best play from both parties leads to a draw. It is straightforward to write a program to play tic-tac-toe perfectly, to enumerate the 765 essentially different positions or the 26,830 possible games including rotations and reflections that exist. The program verifies that each game will end in a draw if each player makes the best move.

Tic Tac Toe is popular with young children. Each game can be finished in just a few moves. This allows for multiple games to be played in a short time and the players can exchange many wins and loses over a number of games. Young children or any first time player will not know the strategies that produce the best so the games do not end in a draw each time. Even going first may not guarantee a win for beginning players. As the children gain more experience they begin to develop better strategies and soon they get to a point where most if not all games end in a draw. At this point most people stop playing this game

There is another version of Tic Tac Tow that redefines what a win is. This version is not well known so you will be able to play the familiar game we all know but with an entirely new outcome. This version changes the way a player views each move and requires a new strategy.

The game is played just like the original version. Each player takes turns placing their X's and O's on the 3 by 3 grid until 1 player has 3 of a kind in a row or neither player has 3 in a row. The difference in the new game is the way we define what a win is.

#### **The new definition of what a “WIN” is.**

One of us will use X's and the other will use O's. We will takes turns placing our X's and O's on the 3 by 3 grid one at a time. **If the game ends in a tie you win. If the game does not end in a tie I win.**

What is so different about this version? It does not matter if you go first or second, If you follow a “best strategy” you can win every time. You second move is to set up a win condition. By your second turn either you win or the other person is forced to win. which is defined as a win for you.

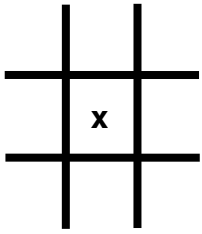
#### **How can that be?**

You are not playing for a draw. You are playing to get a win or FORCE THEM TO WIN. That makes a huge difference in the strategy. If they play poorly you get a win. If they play to block you form winning you can force them to win. No matter who goes first or what squares are selected, on your second move you place your mark so that you can win on your next move. They will block you form winning and **then you can force them to win. Its that easy.**

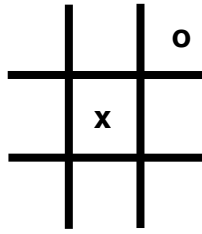
## Examples

### Game 1

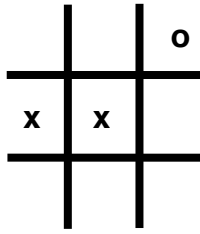
You (x) go first



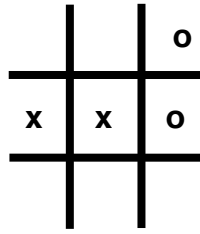
they (o) make any move



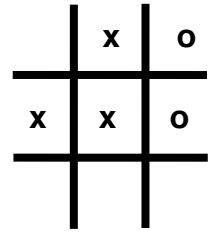
you create a winning position



they must block

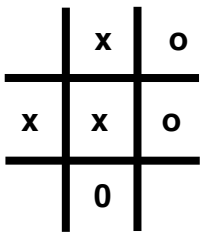


you create a winning position

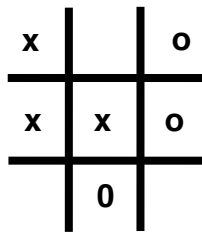


**Note:** On that last move you did not try to block their win. They cannot select the winning square or they lose. Instead of blocking their win you select a win for you. This forces a win for you or a win for them.

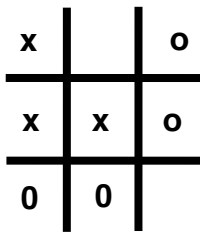
they must block



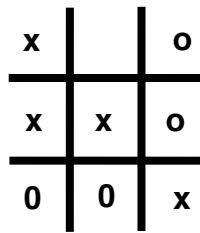
you create a winning position



they must block

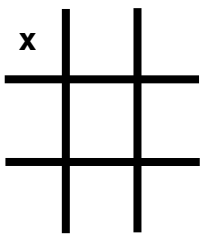


you win

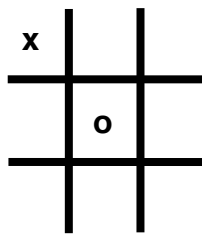


### Game 2

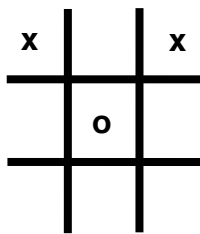
You (x) go first



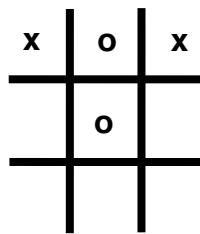
they (o) make any move



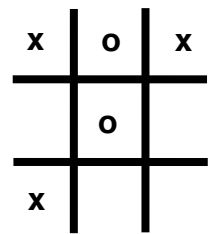
you create a winning position



they must block

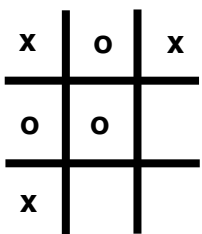


you create a winning position

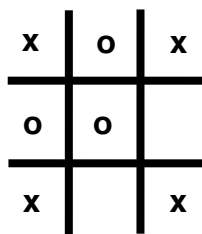


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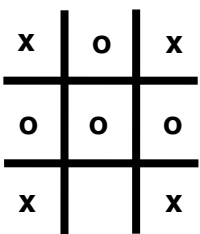
they must block



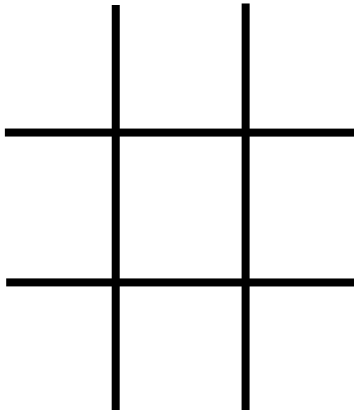
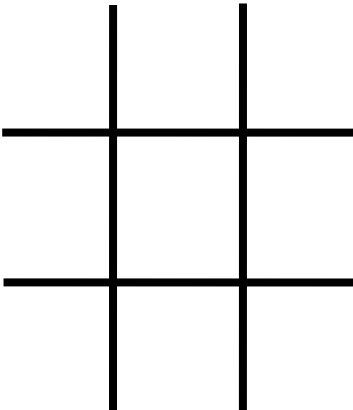
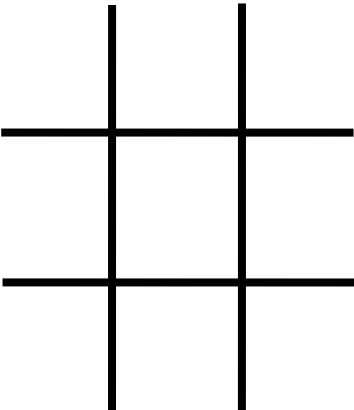
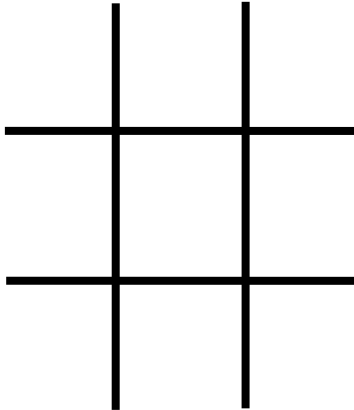
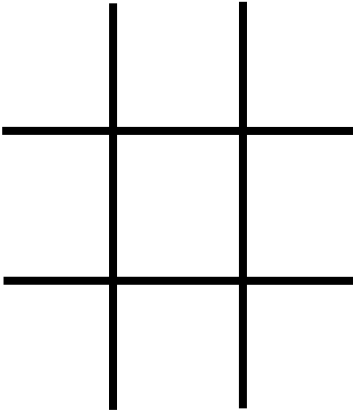
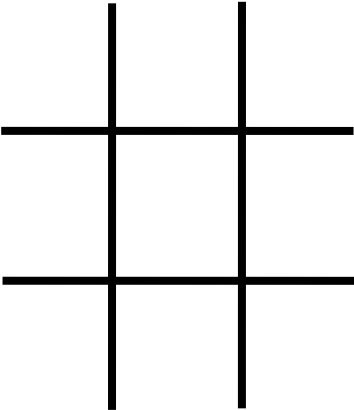
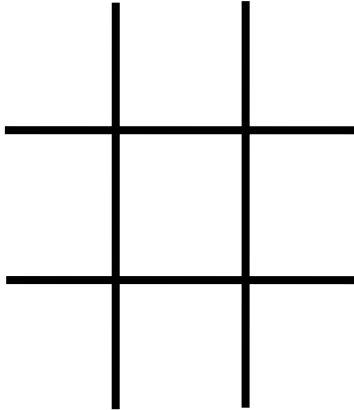
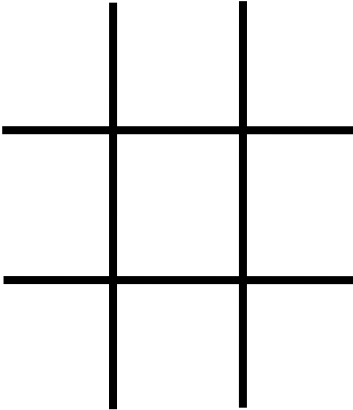
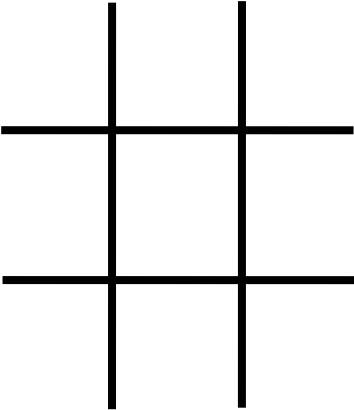
you create a winning position



they must block and you win



Try this new game several times. They it below on the grids provided.



## History

According to Claudia Zaslavsky's book *Tic Tac Toe: And Other Three-In-A Row Games from Ancient Egypt to the Modern Computer*, tic-tac-toe could be traced back to ancient Egypt. Another closely related ancient game is Three Men's Morris which is also played on a simple grid and requires three pieces in a row to finish. An early variation of tic-tac-toe was played in the Roman Empire, around the first century BC. It was called *terni lapilli* (three pebbles at a time) and instead of having any number of pieces, each player only had three, thus they had to move them around to empty spaces to keep playing. The game's grid markings have been found chalked all over Rome. The first print reference to "noughts and crosses", the British name, appeared in 1864. The U.S. renaming of Noughts and crosses as tic-tac-toe occurred in the 20th century.

In 1952, the game OXO, developed by British computer scientist Alexander Douglas for the EDSAC computer at the University of Cambridge, became one of the first known video games. The computer player could play perfect games of tic-tac-toe against a human opponent. In 1975, tic-tac-toe was also used by MIT students to demonstrate the computational power the Tinkertoy computer, made out of (almost) only Tinkertoy's. It was able to play tic-tac-toe perfectly. It is currently on display at the Museum of Science in Boston.

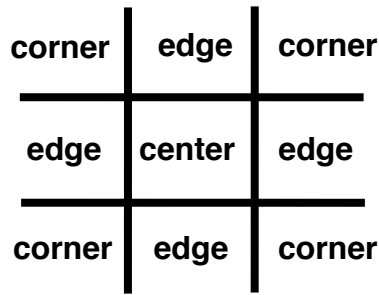
## Combinatorics

When considering only the state of the board, and after taking into account board symmetries (i.e. rotations and reflections), there are only 138 terminal board positions. Assuming that X makes the first move every time:

- 91 distinct positions are won by (X)
- 44 distinct positions are won by (O)
- 3 distinct positions are drawn, which are known as a cat's game.

## Strategy for Best Play for regular tic tac toe

The following guide will allow you to either Win the game or force a Draw, with all possible plays detailed. The chart below labels squares as corner squares, edge squares and the center square.



Player x moves first	Player o moves second
<p><b>x chooses any corner square</b> Then follow the strategy below after O's turn.</p> <p><b>IF O's first move puts an O in the Center Square</b> then place an X in the square caddy-corner from your original X.</p> <p><b>Then two Scenarios will arise:</b> If O plays to a corner square then put an X in the only open corner square. Win on your next turn.</p> <p>If O second move is an O in an edge square then Block O's threatened win. Block and draw.</p> <p><b>IF O's first move puts an O in a Corner Square</b> then place an X in either of the two open corner squares. O must block, then place an X in the only open corner square. You win on your next turn.</p> <p><b>IF O's first move puts an O in an Edge Square</b> then place an X the center square. O must block your threatened win. Then two Scenarios will arise: The O threatens a win. Block and win next turn.</p> <p>The second O does not threaten a win. Place an X the corner square <b>not</b> bordered by an O. Win on your next turn.</p>	<p>X chooses any corner square then <b>O Plays to the Center Square.</b> Then follow the strategy below after x's turn.</p> <p>The X Threatens a Win. Block, which forces X to block.</p> <p><b>Then two Scenarios will arise:</b> The third X threatens another win. Block, which forces X to block. Draw.</p> <p>The third X does NOT threaten a win. Place an O in any open edge square. X must block, which threatens a win. Block and draw.</p> <p><b>One X on a Corner, the other on an Edge</b> Place an O in the corner square caddy-corner to the corner X. Block or play to any square to draw.</p> <p><b>Both X's are on Edge Squares</b> When both X's border a corner square (draw): Place an O in the corner square bordered by the two X's. X must block your threatened win. Place an O in any square. Block and draw.</p> <p>When both X's <b>don't</b> border a corner (O wins!): Place an in O either of the remaining open edge squares. X must block your threatened win. Place an O in either corner square bordered by <b>only one</b> X. Win on your next move.</p> <p><b>Caddy-Corner X's</b> Place an O in any open edge square. X must block your threatened win. Both players block and draw.</p>