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How to Win at Tic-Tac-Toe

By Ryan Aycock

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To Susan and Kellie, who rightfully believed

I was nuts for researching this book.

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Preface

If you're reading this, I'm assuming you already know how to play tic-tac-toe. Notice the name of this book is not "How to Play Tic-Tac-Toe," it is "How to Win at Tic-Tac-Toe." Second, I think we need to get some definitions out of the way. Whenever I say "X", I'm referring to the starting piece. Likewise, an "O" will forever be known as the piece to go second. Now I know some people play by different rules – i.e., one people is X no matter how he starts, but for the purpose of this book, we'll use my style. Just think what would happen if we did not have a set of rules. People might start putting Qs or Rs on the board. It would be pandemonium.

It's also important to note which part of the board I'm referring to. When I say the corners, I am referring to a place such as figure 0.1; sides are represented in figure 0.2; and the center is shown in figure 0.3.

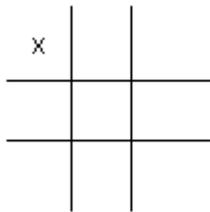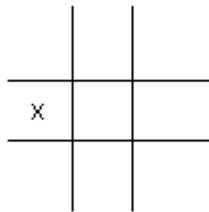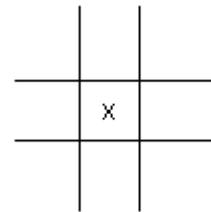figure 0.1   figure 0.2   figure 0.3

Due to the symmetry of the board, I could rotate it in any direction and the outcome would still be the same. For example, if I started in the lower-right corner, the principles of playing there would be the same as playing at the upper-left corner.

Although there are some 300,000 possible tic-tac-toe games, we'll focus on those that are sure to make you a winner.

Chapter 1: The Xs

1.1 Starting from the corners

Most people learn how to play tic-tac-toe with a corner start. It is the easiest way to go because there are so many **guaranteed wins**. A guaranteed win is represented in figure 1.1. The subscripts represent the round – i.e., X_1 is the first X that is played.

X_1	O_1	
O_2	X_3	
X_2		

figure 1.1

Notice that no matter where O_3 is put, X will win. The beauty of starting at the corners is that there are seven guaranteed wins. In fact, the only place O could move in the hopes of not losing is in the center. We'll talk about how to beat the center O_1 later on. But for now, the rest of the guaranteed wins are shown below.

X_1		O_1
	O_2	
X_3		X_2

X_1	O_2	X_2
O_1		
		X_3

X_1	O_2	X_2
		O_1
X_3		

X_1	O_2	X_2
O_1		X_3

X_1	O_2	X_2
	X_3	
O_1		

X_1		X_3
O_2		
X_2		O_1

The goal of a guaranteed win is to lure your opponent into a trap until you are left with two possible victories. However, there comes a time when your opponent will go

for the center. It is at this moment you must go for **symmetry**. Symmetry occurs when whenever someone perfectly bisects the board to make the tic-tac-toe squares look nice. An example is shown in figure 1.2. Notice it just feels right to put the second X in that position.

Now our only hope is that the opponent will continue the symmetry as shown in figure 1.3.

figure 1.2   figure 1.3

It doesn't really matter at which corner O_2 is placed, because victory is yours:

If at any point either you or your opponent breaks symmetry, this match will result in a cat. However, you can still win by placing your X_2 on one of the indicated sides in figure 1.4. So long as your opponent places O_2 in the opposite corner as shown above and below, you will prevail.

figure 1.4

Once you've mastered corner starts, you'll want to move on to the more advanced positions: the sides and the center.

1.2 Starting from the sides

When you begin attacking from the sides, the number of guaranteed wins drops to two. As illustrated in figure 1.5, you want to lead your opponent, making sure X_2 touches O_1.
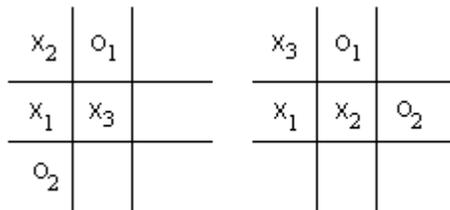

figure 1.5

Remember, the symmetry of the board allows your opponent to place O_1 at the bottom side of the board without changing the game (Be sure not to confuse the terms "symmetry of the board" with "symmetry of movement").

Now that that's out of the way, we need to move on to the more difficult placements of O_1.

First, consider the case of the near corner (figure 1.6). Your best bet would be to place X_2 at the corner horizontal from O_1 (figure 1.7). From there, you only have a 50% chance of winning. Otherwise, you will get a cat. The winning spots for O_2's placement are denoted by asterisks (figure 1.8). An example of a victory is shown in figure 1.9.

O_1		
X_1		

figure 1.6

O_1		X_2
X_1		

figure 1.7

O_1	*	X_2
X_1		
*		*

figure 1.8

O_1		X_2
X_1	X_3	
		O_2

figure 1.9

Now let's consider the case of the far corner. You should take the opposite vertical corner this time. The complete series is drawn out below.

		O_1
X_1		

		O_1
X_1		
		X_2

	*	O_1
X_1	*	*
*	*	X_2

		O_1
X_1	O_2	
X_3		X_2

Notice that our chances of winning based on O_2's placement almost doubled.

Next, let's focus on the far side. You should take a far corner and follow the logic below.

X_1		O_1

X_1		O_1
		X_2

	*	*
X_1	*	O_1
	*	X_2

	O_2	
X_1		O_1
X_3		X_2

Finally, let's consider what happens when O_1 is placed in the center. Our job now becomes exponentially harder. First, winning requires the opponent to cast a blind eye when it comes to O_2. And second, you could actually *lose* if you should make a fatal mistake on the placement of X_2.

To win, your opponent would have to fall for a symmetry trap:

X_3	X_2	
X_1	O_1	
	O_2	

or

X_3		X_2
X_1	O_1	
	O_2	

There are a few other places where the opponent can put O_2. But for the most part, consider this one a cat.

Now for the loss. If you should get lulled into symmetry, you could actually come away a loser on this one. Consider the following match:

X_3		
X_1	O_1	X_2
O_3		O_2

Just follow the progression of the game to see a startling outcome.

Now let's move on to the final starting position, the center.

1.3 Starting from the center

The center is always a great place to start. An opponent is always thrown off whenever X_1 is placed right in the heart of the board. Thanks to symmetry, there are really only two possible games to consider. And luckily, one of them is a guaranteed win.

If your opponent should place O_1 on one of the sides, simply pick any one of the corners and victory is yours:
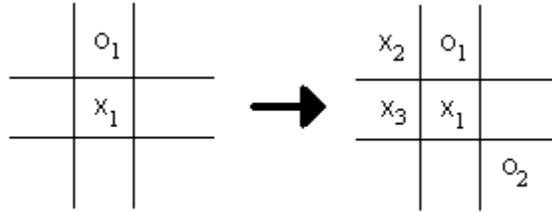
If your opponent should chose a corner (figure 1.10), you should back into to diagonally-opposite corner and wait for placement of O_2 (figure 1.11). Just as when you started from the side, there are several places which will grant you a win (figures 1.12). And as before, I have provided an example match (figure 1.13).
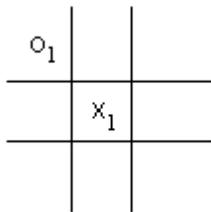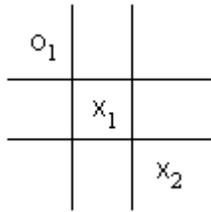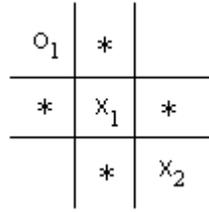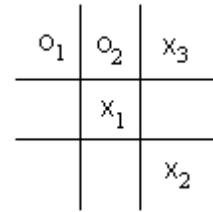

| figure 1.10 | figure 1.11 | figure 1.12 | figure 1.13 |

1.4 Statistics

In this section, I'll attempt to make up some statistics on what your chances are of winning based on your starting position. Make note, I know nothing about formal statistics. Everything you see in this section is purely guesswork on my behalf. If you are the type of person who gets squeamish at the site of fuzzy math, now would be a good time to move on to the next chapter.

Now that you've had a chance to see what it's like to be an X, let's focus our attention to the other side of tic-tac-toe, the Os.

Chapter 2: The Os

2.1 Starting from the corners

As you may have noticed from the previous chapter, whenever O_1 is placed on a side, X is guaranteed a win. **Therefore, for all starts, O_1 should never be placed on a side**. The corner start also presents us with the problem of guaranteed wins everywhere except for the center. When you are O, should place O_1 at the center, and then avoid falling into a symmetry trap. Using this simple method, you will always get a cat. Eventually, your opponent will get bored and will stop with the corner starts.

2.2 Starting from the sides

As you may have also have noticed earlier, starting from the center is your best option. From there, you should attempt to block your opponent's chance at a win by placing O_2 between the first two Xs:
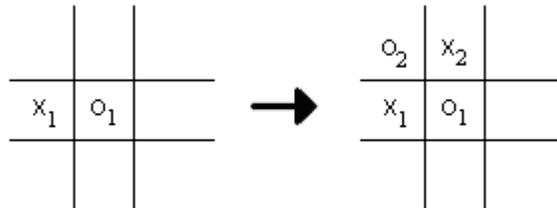
From, there, you will get a cat every time.

Now for the good news. It is actually possible for O to win during X's side start. You have already seen one example of this in section 1.2. The image is redrawn below:
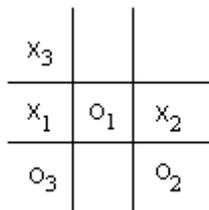
If your opponent should actually fall into a symmetry trap, victory is yours for the taking. There are several more instances when victory is yours for the taking. These involve placing O_1 at a corner and hoping for the best (figure 2.1). Just as with the previous example, winning on X's side start is more dumb luck than it is logic. Most of the time, however, you will end up with a cat so long as you avoid the hot spots of figure 1.12, which you should be able to do since you have read this book.

O_1		O_3
X_1	O_2	X_2
	X_3	

O_2	X_3	O_1
X_1		
X_2		O_3

figure 2.1

2.3 Starting from the center

Also mentioned in chapter 1 was O_1's placement at a corner whenever X starts at the center. When your opponent backs in the farthest corner (figure 2.2), simply take another corner and wait for the cat (figure 2.3).

O_1		
	X_1	
		X_2

O_1		
X_3	X_1	
O_2		X_2

figure 2.2   figure 2.3

If X_2 is placed any where other than the farthest corner, that match will also result in a cat. From X's center start, there are no possible O wins.

About the author

Ryan Aycock is an undergraduate at the University of Florida where he is double majoring in physics and religion. He has been an avid tic-tac-toe player since 1986. He is hoping a gullible publisher will pick up this book and sell thousands of copies to gullible people.