

Variations of Tic Tac Toe

Overview:

The game tic-tac-toe has many interesting variants. While students usually all know the original game, the variants are worth playing because they will require students to analyze the game all over again and look for a new strategy. You can play some of these as exhibition games or ask students to play them as transitional activities.

Concepts:

The notion of strategy.

Vocabulary:

Strategy

Connection to other games:

Like Nim and One-Piece Chess, Tic-Tac-Toe is a two-person perfect-knowledge game of strategy. Tic Tac Toe is a little different from these other games because (like 15 Game), there is no winning strategy. When the game is well played on both sides, it will end in a draw.

Simple Variations of Tic Tac Toe

1. Tic-tac-toe to lose: Players play tic tac toe with the usual rules, but the player who puts three markers in a row loses, rather than wins. This is a good way to get students to re-think the rules, but it is not a good game to play for very long. Students quickly realize that it always ends in a draw, with any serious attention to playing at all.
2. Tic-tac-toe with x's or o's: Players play tic tac toe with the usual rules, except that a player, in his turn, can place either an x or an o in any square. The first player to get three in a row of either symbol is the winner.

Again, this game quickly becomes dull, but is good for getting students to re-think rules and strategies. It is important for students to keep track of whose turn is it, or they will begin to argue. It is not possible (as it is in normal tic-tac-toe) to tell whose turn it is from looking at the board alone.

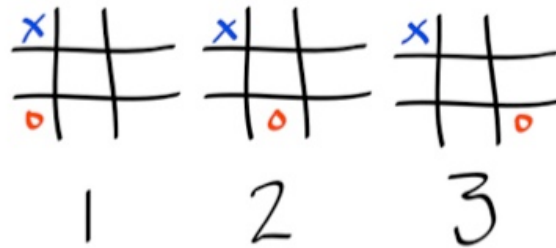
3. Combining versions: You can even combine both variations and play tic-tac-toe to lose, with each player allowed to place either an x or an o.

Games 1-3 are useful to clinch the notions of rules and strategy. The rules of a game are its axioms: the assumptions we start with. The strategies of a game are its theorems: propositions that follow from the rules. It is not necessary to make these concepts conscious for the students to be learning about them. It is enough, on this level, for students to realize that there are rules given, and strategies implicit, but not stated, in the rules.

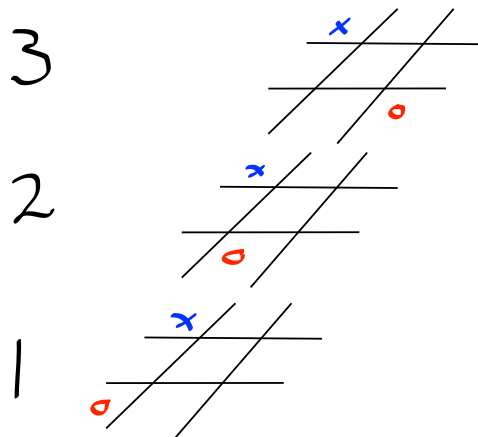
Tic Tac Toe in Higher Dimensions

4. Three dimensional tic-tac-toe: This is a better game than the previous. It is fun to play, and students learn about visualization in three dimensions.

Put three tic-tac-toe boards on the chalkboard. These are the three floors of a building. You can win on any one floor, but also by forming a row of three up the side of the building, or diagonally up one side, or diagonally through the center of the building (the center square of the center board). In the example below, x and o each have 3 in a row.



Below, a “3D” version of the same positions is shown. Drawing it this way may help students to see the more difficult three-in-a-row combinations.



Many students have trouble visualizing the winning positions. It is important to play many exhibition games and discuss where the winning positions lie, so that students begin to visualize them. For many groups, it may be appropriate to play only exhibition games, as long as students are paying attention and visualizing the wins.

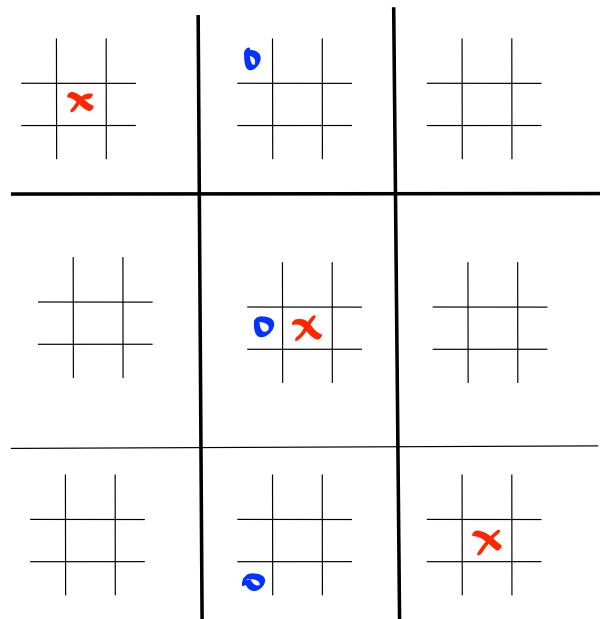
You can combine this game with variants 1-3. But the straightforward rules, on a three-dimensional board, are usually sufficient to engage students and have them learn mathematics.

Very young students (earlier than 4th grade) will not be able to visualize the board. Typically, they play on the first floor until there is a draw, then go to the second floor, and so on. There seems to be a developmental step necessary for students to visualize three dimensions. Happily, the vast majority of students in fourth grade or higher have made this step.

5. Four-dimensional tic-tac-toe

This game should be played only if and when students are comfortable with and enjoy playing three-dimensional tic-tac-toe.

On the chalkboard, draw a huge tic-tac-toe field. In each square, draw a miniature tic-tac-toe board, nine boards in all (plus the huge one). Players take turns as usual in tic-tac-toe, trying to form a row of three of their counters (X or O's).



Players can win within any single tiny square, or across three squares which form a row, column or diagonal in the huge tic-tac-toe board. That is, there are eight possible 3-dimensional games contained within this one.

Players can also win with a row of three squares which include the center square of the center tic-tac-toe board, plus two other squares which are symmetric to each other in the center square.

On the one hand, the three- and four-dimensional versions of tic-tac-toe are actually easier to win than the two-dimensional version. If the first player claims the center square, it becomes more and more difficult to block him, as the dimension increases.

This is far from apparent to the casual or novice player. Both games are enjoyable even without being solved.

However, and especially in the four-dimensional version, the first player quickly wins. Students find this out, even without having any idea at all of a general strategy.

To add to the enjoyment of the game, try the following variation: even after a player has achieved a single row of x's or o's, the two players continue. They score points each time they complete a row of their marker, until one of them achieves an agreed upon number of points (11 is a good number to agree on!).

It is important that players keep careful track of whose turn it is: it becomes difficult to determine, from the board, who goes next, and arguments can ensue.

The point of this game is to practice (three dimensional!!) visualization. It is not expected that students form a strategy or 'solve' the game.