by Mary Beth Cox
Illustrations by Matthew Billington

Let's Pl a Ga

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You can even go first.

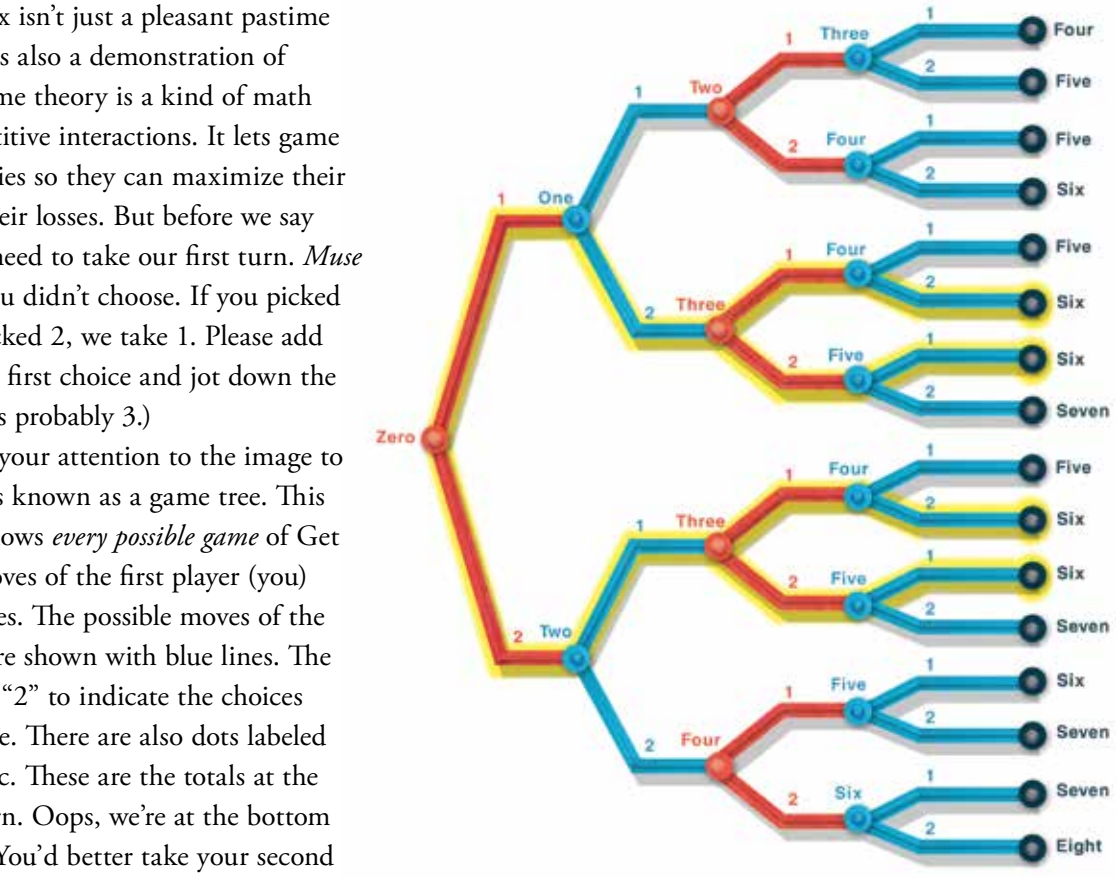
Ever competed against a magazine? Well, *Muse* hereby challenges you to a game of Get to Six. We'll play as you read this article—this is how: The first player (you, as promised) starts by choosing either the number 1 or the number 2. Then the second player (*Muse*) will choose 1 or 2. We'll add our choice to yours to get a total. Then you and *Muse* will continue to take turns picking 1 or 2. Each choice will be added to the total. The player who first gets the total to equal 6 wins. Ready? For your first turn, do you choose 1 or 2?

Fair Warning

This game of Get to Six isn't just a pleasant pastime between old friends. It's also a demonstration of basic game theory. Game theory is a kind of math that focuses on competitive interactions. It lets game players evaluate strategies so they can maximize their payoffs or minimize their losses. But before we say more about math, we need to take our first turn. *Muse* chooses the number you didn't choose. If you picked 1, we take 2. If you picked 2, we take 1. Please add our first choice to your first choice and jot down the total. (Hint: the total is probably 3.)

Now please direct your attention to the image to the right. This is what's known as a game tree. This particular game tree shows *every possible game* of Get to Six. The possible moves of the first player (you) are shown with red lines. The possible moves of the second player (*Muse*) are shown with blue lines. The lines are labeled "1" or "2" to indicate the choices each player might make. There are also dots labeled "zero," "one," "two," etc. These are the totals at the end of each player's turn. Oops, we're at the bottom of another paragraph. You'd better take your second turn. Do you choose 1 or 2? Add your choice to get the new total. (Hint: the total is now either 4 or 5.)

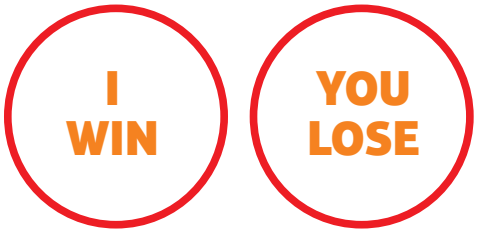
The game tree for Get to Six. The second (blue) player's dominant strategy is highlighted in yellow.



Game Over

Back to the game tree. Special paths through the game tree are highlighted in yellow. These paths are all the games in which two things happen: you choose first, and then *Muse* always chooses the number you didn't. On the yellow paths, dots labeled "six" show up only after blue turns, never after red turns. This means in the yellow path games, *only the second player wins!* The second player always choosing opposite from the first player is a "dominant," or winning, strategy. The second player can't lose, no matter what the first player does. So for our second turn we select the number you didn't choose on your second turn. That's 6—*Muse* wins.

We're sorry to beat a



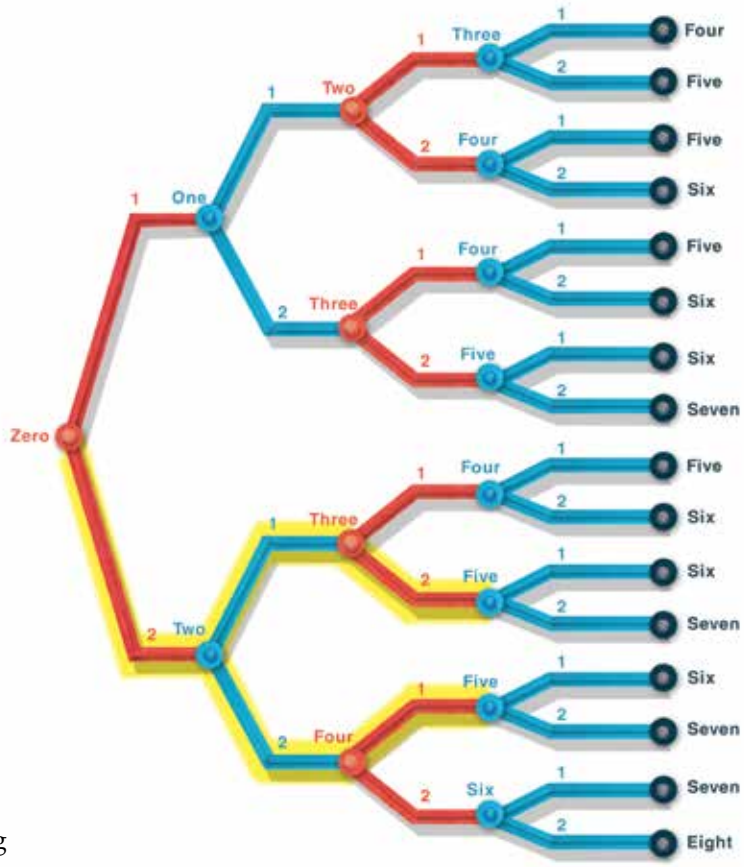
PRESIDENT OBAMA ON GAME THEORY

President Obama once said that the conflict between Russia and Ukraine over the region called the Crimea was "not a zero-sum game." The President is obviously a student of game theory. In a zero-sum game, for one player to gain, the other must lose. Gains (+) and losses (-) always sum to zero. A game is not zero-sum when all players can win or all can lose.

GAME THEORY WINS AN OSCAR?

A Beautiful Mind was the Academy Award winner for Best Picture in 2001. The film is about the brilliant but troubled mathematician John Nash. Nash was awarded the 1994 Nobel Prize in Economics for his contributions to game theory. He is particularly famous for his discovery of the Nash Equilibrium. That's the stable point in a game where no player benefits from a change in strategy, and all the players know it.

The game tree for Get to Five. The first (red) player's dominant strategy is highlighted in yellow.



good friend, but we wanted you to experience game theory's power. We decided on our strategy a long time ago, in a place far, far away. We didn't know what your choices would be. And yet, the Get to Six game tree guaranteed us a victory.

Game theory is useful for all kinds of games, even complex ones like poker and chess. It even applies to multi-player interactions that aren't usually thought of as games. Game theory can be used to model economics and business, politics and elections, diplomatic and military engagements, biological evolution and ecology, and even dating. In fact, dating scenarios are often examples in game theory textbooks.

Play It Again?

So how about another game of Get to Six? Don't say no—you're now a math-savvy competitor. Next time, insist on going second. Then you can use the dominant strategy to score a win.

Or maybe you'd like to be a game changer? Take a look at the game tree on this page. It's the same tree as before, but different paths are yellow. These yellow paths are games in which: you go first and choose 2, and next you choose the number your opponent didn't choose. In these games, dots labeled "five" appear only after red turns. So if you must go first, suggest playing Get to *Five* instead—you can still win every time! That's another important game theory lesson. You can often improve your chances by negotiating rules or goals.

Want to apply game theory to other games? Check out Gambit at gambit.sourceforge.net. Gambit's free software library generated our game trees. Of course, you can draw the same trees with a ruler and pencil. Map out the best strategies for all your favorite games—before your competition does!

Mary Beth Cox is a chemist from Texas. She's never met a game she didn't like.

FOR SERIOUS GAMERS ONLY

Question: In the second game tree, the red player can Get to Five first in the game that goes 1,2,2. But that path is not highlighted yellow. Why not?

Answer: While 1,2,2 is a winning path for red, it is not a dominant strategy. If red chooses 1 first, blue still has winning paths too. They're 1,1,1,2 or 1,1,2,1.