Quantum Go Fish

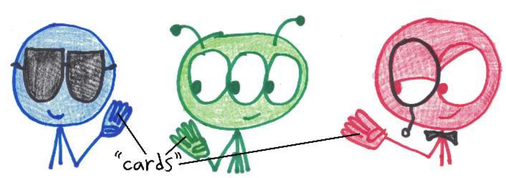
A Game of Mysterious Fingers

As we begin this final chapter, conscience compels me to confess that I have committed in this book—on top of any number of honest and inadvertent errors—one knowing and deliberate lie. Remember when I said Quantum Tic-Tac-Toe was the trickiest game in the book? I am sorry that I deceived you.

The real winner is this glorious monster. I consider it a cross between a logic puzzle, an improv comedy show, and a collective hallucination, played with the strangest deck of cards you've ever seen. Or not seen. To be candid, I'm still wrapping my head around it. Anyway, for a book that started with a childhood game, I can think of no better end than this doozy, whose primary fan base is math PhD students.

How to Play

What do you need? Anywhere from 3 to 8 players. Each begins the game by holding up four fingers. These are the "cards" in the deck.

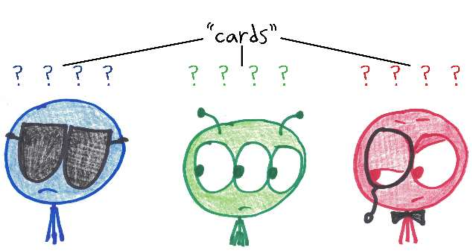


What's the goal? There are two ways to win:

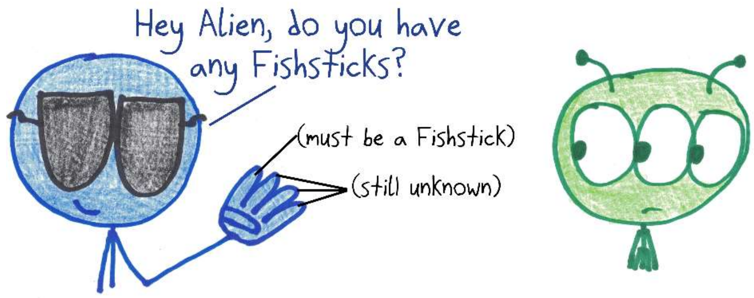
1. Prove that you have four cards in the same suit.
2. State exactly what suits every player has in their hand.

What are the rules?

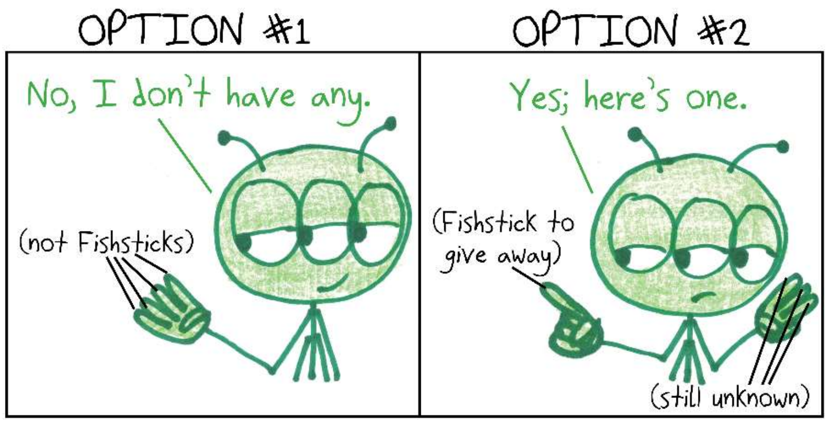
1. To begin, **no one knows the suits of their own (or anyone else's) cards.** All is a mystery. We only know that there are **4 cards per suit**, and as many suits as there are players.



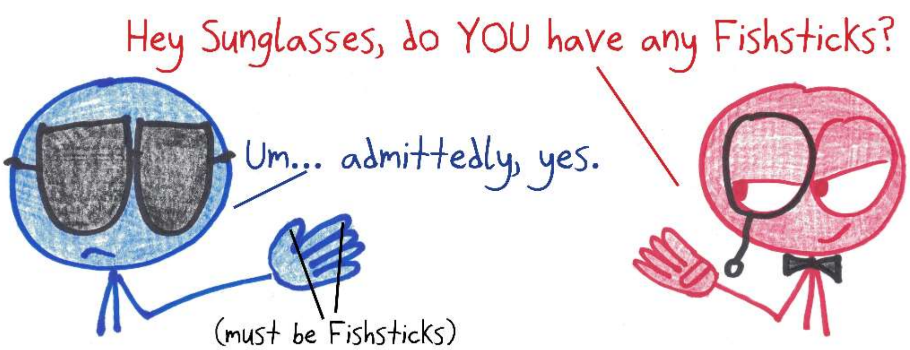
2. On your turn, pick another player, and **ask them if they have any cards from a particular suit.** (The first to reference a new suit may make up a silly name for it.) Note that **you may only ask for a suit you already possess**; thus, by asking for "Unicorns," you are committing one of your as-yet-unknown cards to being a Unicorn.



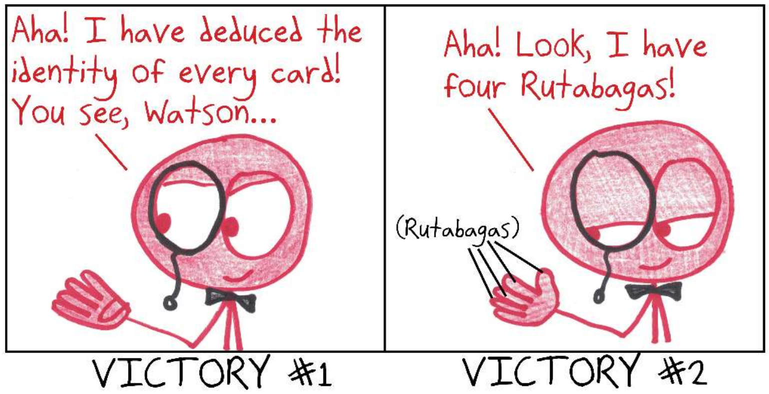
3. The asked player can respond in one of two ways:
   a. **"No, I don't have any."** Thus, all their cards must belong to other suits.
   b. **"Yes, here is one."** In this case, they give **precisely one card** to the asking player. Their other cards remain a mystery (and might even belong to the same suit).



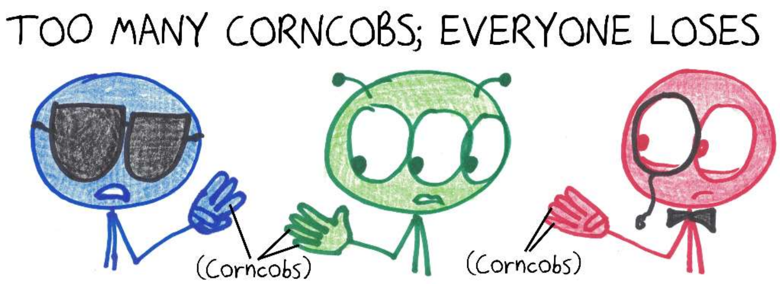
4. **Sometimes this decision will be forced**. For example, if you've already committed to having Radishes, and I ask you for Radishes, then you must give me one. **Otherwise, the asked player may respond whichever way they wish.**



5. You can win in two ways:
    a. At the end of your turn, **state exactly what cards each player must have**.
    b. At the end of your turn, **prove that you have four cards in the same suit**.

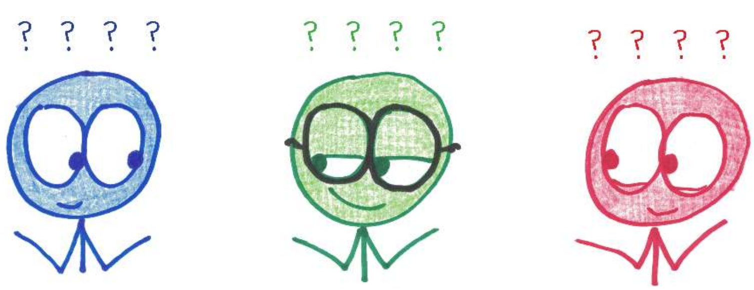


6. However, if a paradox occurs—meaning that the players collectively possess 5 or more cards all in the same suit—then **something has gone wrong, and everybody loses**.



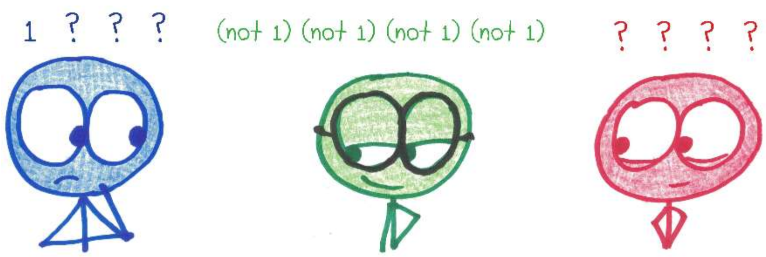
Tasting Notes

I myself had no idea how this game worked until I saw a sample round. (After that, I had at least *some* idea how it worked.) Here's a step-by-step illustration with three players. They begin with 12 cards: four each of three different suits. No one knows what cards they (or anyone else) has.



Xia goes first and asks: "Yael, do you have any 1's?"[1] Yael chooses to reply "no."

[1] In a proper game, Xia would name this suit something fun, like "Narwhals," but we'll use "1's" for clarity.



Yael goes next and asks: “Zoe, do you have any 2’s?”

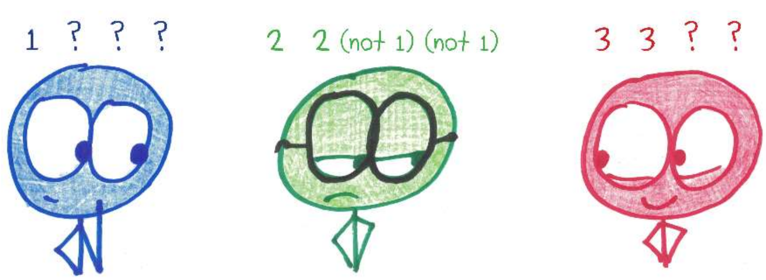
Zoe chooses to reply “yes.”

The result leaves Zoe with three cards, and Yael with five. Of these, two must be 2’s: one implied by asking, and one gained from Zoe.

Zoe goes next and asks: “Yael, do you have any 3’s?”

Yael may feel tempted to say “no.” But this would lead to a game-destroying paradox. Yael has three cards which are not 1’s; if they’re not 3’s either, then they must be 2’s. That would give Yael five 2’s, which is an impossibility.

Therefore, Yael must say “yes,” and give a 3 to Zoe.



Xia goes next and asks Zoe, “Do you have any 1’s?”

Clever move. If Zoe says no, then neither Yael nor Zoe would have any 1’s. Thus, Xia would have them all, and could claim victory.[2] Instead, Zoe says “yes,” and gives a 1 to Xia, who now possesses at least two 1’s.

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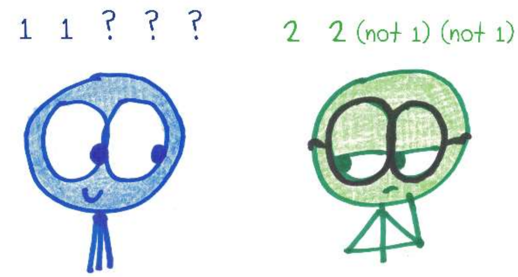
[2] Some players forbid starting with four cards all of the same suit; under that rule, Zoe’s saying “yes” here would create a paradox, losing the game for everyone.



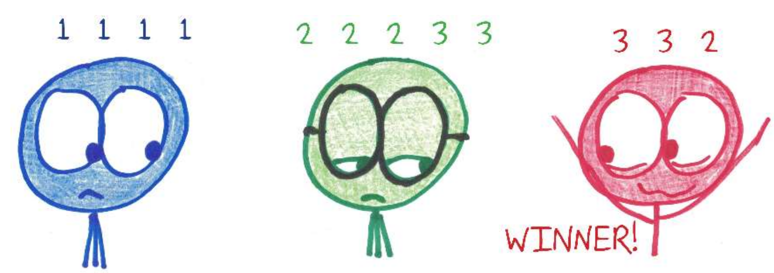
Yael, with the next turn, asks, “Xia, do you have any 3’s?” This means that one of Yael’s remaining cards must be the third 3.

Xia chooses to reply “yes,” and gives the final 3 to Yael. All the 3’s are now spoken for. Moreover, since Yael’s final card can’t be a 1, and can no longer be a 3, it must be a 2.

The next turn falls to Zoe who asks, “Xia, do you have any 2’s?”

This means Zoe’s final card is a 2. Indeed, it’s the last 2, which means that Xia can’t possibly have one. Why did Zoe even bother to ask?

Because, with all the 2’s and 3’s accounted for, Zoe knows that Xia’s remaining cards are 1’s. By declaring and explaining this knowledge, Zoe wins the game.[3]



Easy like Sunday morning, right?

Okay, maybe not. Some mathematicians I know like to forbid pencil and paper, forcing you to keep track of the game entirely in your head. “Though that’s fun,” says Anton Geraschenko, “I came up with a physical deck for playing the game which automatically does a lot of the bookkeeping for you, freeing your brain cycles up to strategize.”

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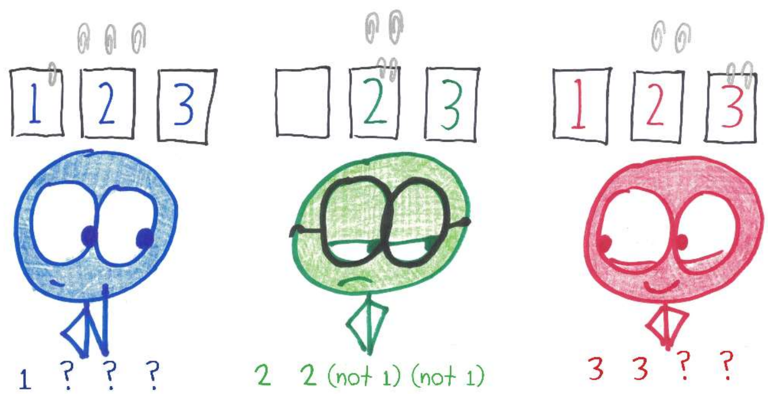
[3] Note that Xia, despite ending the game with all four 1’s, began with only three, then later gained one from Yael.

I heartily recommend Anton's system. Here's what you need:

1. **Four paper clips** per player (representing your cards).
2. Assuming you have **N** players, each needs **face-up pieces of paper numbered 1 to N** (representing the possible suits that you might possess).

As you play, keep track of the evolving game state via these steps:

1. If you determine that you have none of a suit (because you've answered "no" or because others have them all), **turn the corresponding piece of paper face-down**.
2. Your **unattached clips may belong to any of the face-up suits**.
3. If you determine a card's suit, **attach that paper clip to the corresponding piece of paper**. If you have multiple of that suit, attach multiple clips.



Variations

Lose a Turn: If you give an answer that creates a paradox, then not everyone loses—just you. As a penalty, you must sit out the next round.

Playing On: If you achieve four cards in a suit, lower those four fingers. The only way to win the game is to run out of fingers. (Also, no one can start with four cards of the same suit.)