

MATH CIRCLE TTU

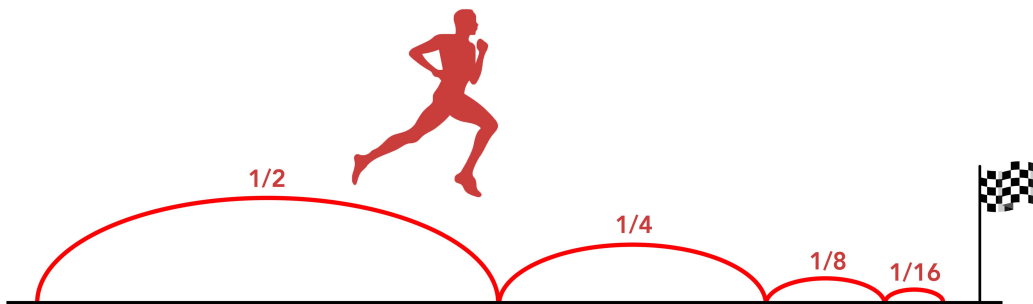
Logic

Mathematical Paradoxes

$$\begin{aligned}x^2 - x^2 &= x^2 - x^2 \\x(x - x) &= (x + x)(x - x) \\x &= (x + x) \\x &= 2x \\1 &= 2\end{aligned}$$

Definition and Example

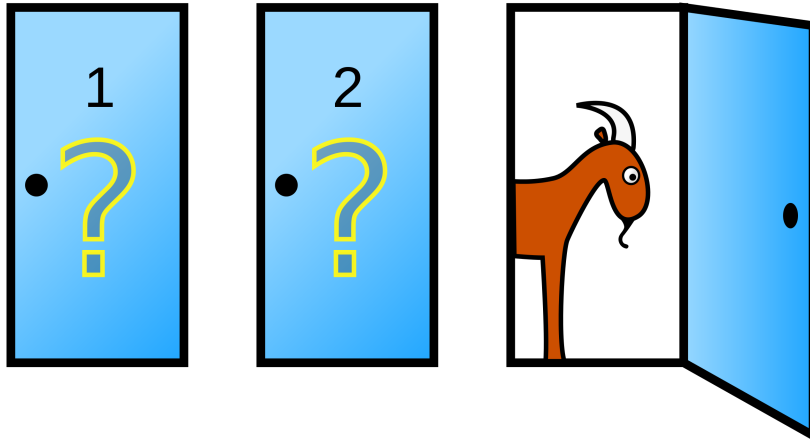
Definition. A **paradox** is a statement that goes against one's intuition or common sense. Despite this, some paradoxes are true and others not.



Question. Imagine yourself as a sprinter. In your race to the finish line, you run first half the distance. From there, you run half of the remaining distance (or, one fourth). Then again, you run half of the remaining distance (or, now, one eighth). And you continue like that. Can you reach the finish line?

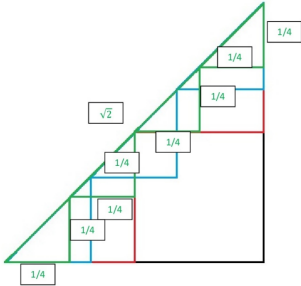
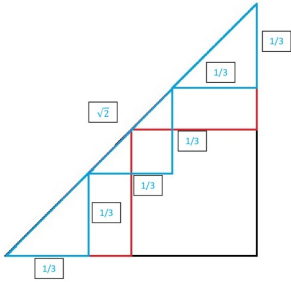
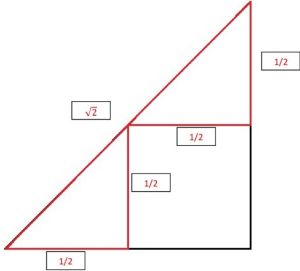
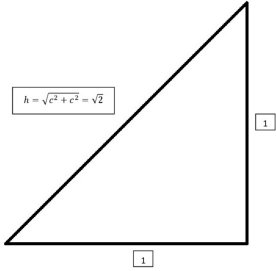
An Example to Play: The Monty Hall Problem

Suppose you are on the game show “Let’s Make a Deal” whose host was Monty Hall. You are given the choice of three doors. Behind one door is a car, while behind the others, there are goats. Once you pick up a door, the host (who knows what is behind every door) opens another door behind which there is a goat. The host then gives you the opportunity of changing doors.



Question. If you want to win the car, what would be best: change the door or stay with your original pick? Let’s play!

Stairs Vs Ramp



Banach-Tarski Paradox

Given a ball there exists a decomposition of the ball into pieces, which can then be put back together (like a puzzle) in a different way to obtain two identical copies of the original ball.

