Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Hidden Dimension of SET: The Classification of Magic SET Squares

Eric Chen, William Du, Tanmay Gupta, Alicia Li, Srikar Mallajosyula, Rohith Raghavan, Arkajyoti Sinha, Maya Smith, Matthew Qian, Samuel Wang, Tanya Khovanova

PRIMES STEP Junior Group, led by Tanya Khovanova

MIT

June 6, 2020

Table of Contents

1 The Game of SET and Magic SET Squares

2 Classifying and Counting Magic SET Squares

3 Magic SET Squares and Group Theory

4 SET Tic-Tac-Toe

The Game of SET

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Definition

SET is a card game with a deck containing 81 unique cards. Each one has a different value for four different features: color, shape, shading, and number.

Color	Red	Shading	Empty
	Green		Striped
	Purple		Solid
Shape	Oval	Number	1
	Diamond		2
	Squiggle		3

Definition of a set

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Definition

A **set** is a group of three cards, where in each feature, all values are either the same or different.

Definition of a set

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Definition

A **set** is a group of three cards, where in each feature, all values are either the same or different.

Definition

The **order** of a set is the number of features that are different across that set. The order can range from 1 to 4.

Definition of a set

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

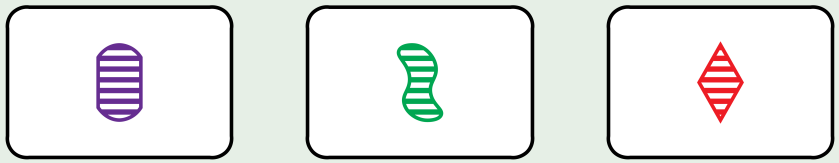
Definition

A **set** is a group of three cards, where in each feature, all values are either the same or different.

Definition

The **order** of a set is the number of features that are different across that set. The order can range from 1 to 4.

Examples



This is an example of a set, with shading and number being the same, but colors and shapes being different. It has order 2.

Sets (continued)

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

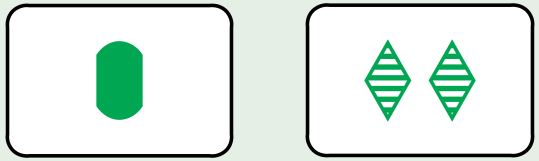
Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

A set is defined by two cards. Try it out: what would be the third card here?

Examples



Sets (continued)

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

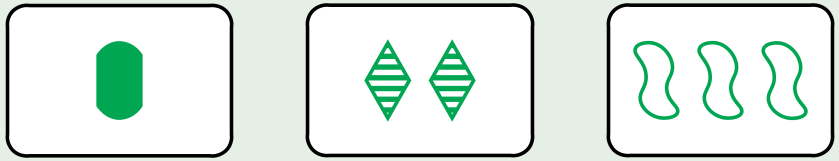
Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

A set is defined by two cards. Try it out: what would be the third card here?

Examples



This set has order three because the cards differ in every feature but color.

Magic Set Squares

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Definition

A **magic set square** is a three-by-three table of set cards such that each row, column, diagonal, and anti-diagonal is a set.

Magic Set Squares

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

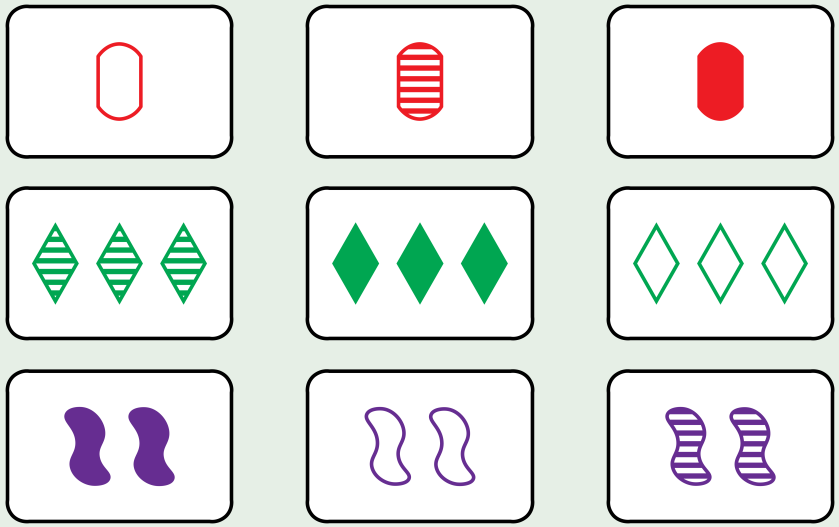
Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Definition

A **magic set square** is a three-by-three table of set cards such that each row, column, diagonal, and anti-diagonal is a set.

Examples



Magic Set Squares (continued)

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

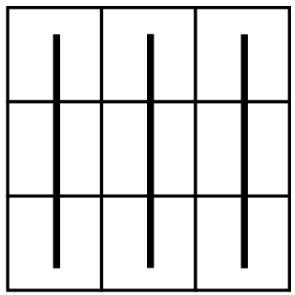
Magic SET Squares and Group Theory

SET Tic-Tac-Toe

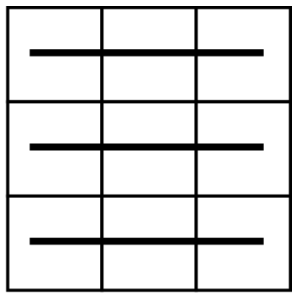
Each magic set square contains 12 sets.

Definition

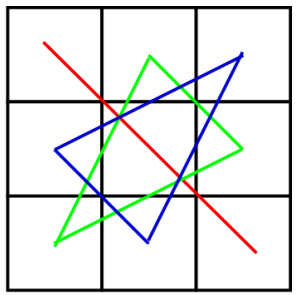
These twelve sets are broken into four groups, called **triplets**, and are pictured below. All three sets in the triplet are the same order.



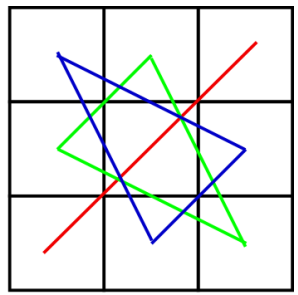
(a) Columns



(b) Rows



(c) Diagonals



(d) Anti-Diagonals

The Number of Sets

Hidden Dimension of SET: The Classification of Magic SET Squares

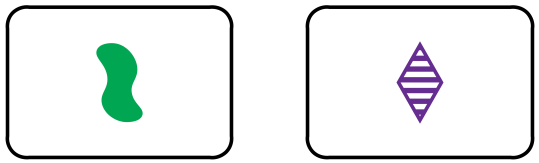
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



- 81 ways to pick first card, and 80 ways to pick the second.
- 6 ways to rearrange cards
- $\frac{81 \cdot 80}{6} = \boxed{1080 \text{ sets}}$

Magic SET Squares With The Same Cards

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

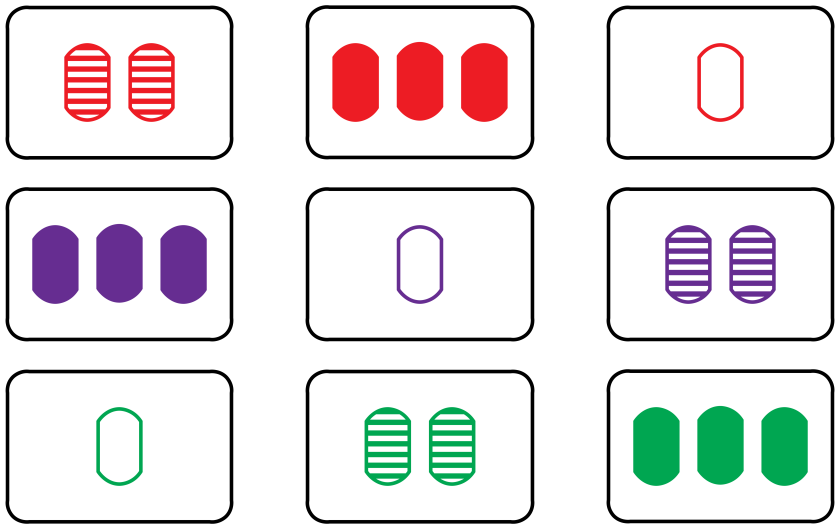
Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Theorem

2 bottom corners and center cards define a **unique** square



- Square has any 2 cards' completing card
- 2 cards for bottom corner: $9 \cdot 8$
- Center card possibilities: 6
- $9 \cdot 8 \cdot 6 =$ 432 squares with same cards

Counting the Number of Magic SET Squares

Hidden Dimension of SET: The Classification of Magic SET Squares

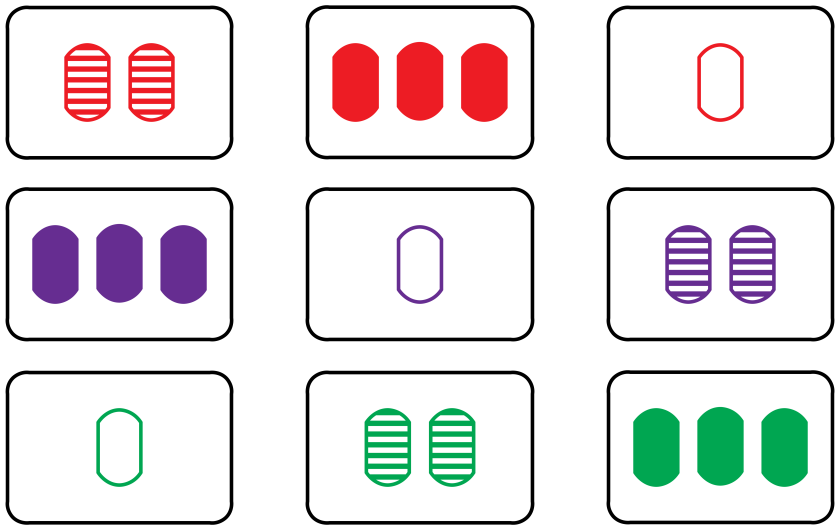
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



- In a Magic SET square, there are 81 ways to pick the bottom left corner, and 80 ways to pick the bottom right corner.
- The middle card can't complete the set, so we have 78 options
- $81 \cdot 80 \cdot 78 =$ **505440 squares**

Order of a Magic Set Square and its diversity

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

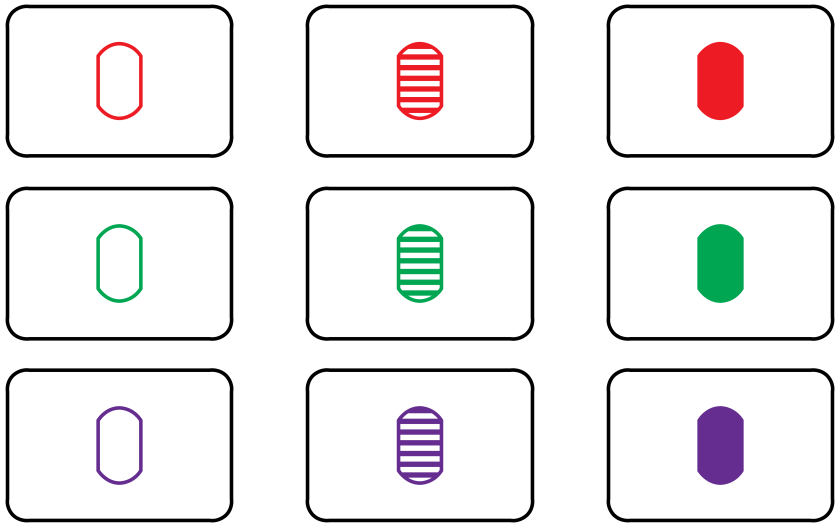
SET Tic-Tac-Toe

Definition

The **order** of a Magic SET Square is the number of features that are not the same for all the cards in the square.

Definition

The **diversity** is the average of all the orders of the triplets and will always be three fourths of the order of the square.



Our Classification

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

- Magic SET squares with same orders for row/column and diagonal/anti-diagonal are same type
- Row, columns, diagonals, and anti-diagonals can be permuted in different ways
- Magic SET squares that can geometrically transformed to each other are same type
- Notation: (x-y;z-w). x-y represent the row and column(interchangeable) and z-w(also interchangeable)

The Number of Squares of Each Type

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Type	Order	Number of Squares
(1-1;2-2) and (2-2;1-1)	2	3888
(1-2;1-2)	2	15552
(1-2;3-3) and (3-3;1-2)	3	15552
(1-3;2-3) and (2-3;1-3)	3	31104
(2-2;2-3) and (2-3;2-2)	3	31104
(1-3;4-4) and (4-4;1-3)	4	10368
(1-4;3-4) and (3-4;1-4)	4	20736
(2-2;4-4) and (4-4;2-2)	4	7776
(2-4;2-4)	4	31104
(2-3;3-4) and (3-4;2-3)	4	62208
(2-4;3-3) and (3-3;2-4)	4	31104
(3-3;3-3)	4	31104

Sharing Features

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

For each order distribution of triplets of a magic set square, there is a specific distribution of features assigned to each triplet. We can find this by using two principles:

- each feature is either the same in all triplets or different in three triplets
- for any two triplets the union of all features that are different has to equal to the order of the square

Review of Group Theory

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Definition

A **stabilizer** of a card is a subgroup that keeps this card the same.

- The group we will be studying is the group of that acts on the cards, sets, and squares
- The group has a total size and a stabilizer subgroup which keeps the element in place
- The orbit is how many different states are possible. All the cards are in the orbit.

Theorem

$$\text{Size of an orbit} = \frac{\text{Size of Group}}{\text{Size of Stabilizer}}$$

Group Size of Cards

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

- Four features each with 3 values
- Values for a feature can be shuffled in six ways
- Four features can be shuffled 24 ways
- Total group size: $24 \cdot 6^4$ which is 31104, a factor that appears many times
- This is the total group size for cards, sets of an order, and squares of an order

Stabilizers of Cards

Hidden Dimension of SET: The Classification of Magic SET Squares

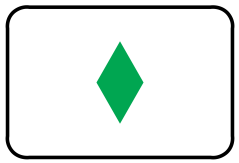
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



- Shuffle 4 features(if shuffled to the right value. In the example color can be shuffled for shape if green is shuffled with diamond)
- 2 values per feature are not being used that can be shuffled

Total Group Size: $24 \cdot 6^4$
Stabilizer: $24 \cdot 2^4$
Dividing, we get 81, the number of cards in a SET deck.

Stabilizers of Sets

Hidden Dimension of SET: The Classification of Magic SET Squares

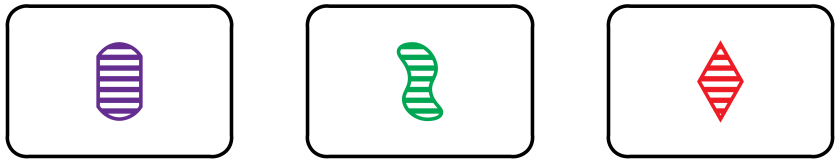
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



- Set of order k
- k features that differ
  - Can be shuffled (permuted): $k!$
- $4-k$ features are the same.
  - Can be shuffled (permuted): $(4-k)!$.
  - Swap 2 values not present: 2^{4-k}
- Shuffle/Permute the 3 cards: $3! = 6$.

Stabilizers of Sets

Hidden Dimension of SET: The Classification of Magic SET Squares

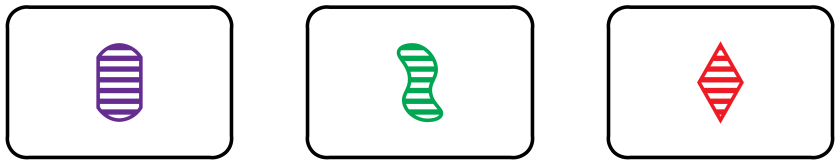
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



Stabilizer of a set of order k has size: $\boxed{6 \cdot 2^{4-k} \cdot k! \cdot (4-k)!}$

Theorem

Size of an orbit $= \dfrac{\text{Size of Group}}{\text{Size of Stabilizer}}$

Order 2: $\frac{31104}{96} = 324$

SET Tic-Tac-Toe

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Two players are presented with a magic set square. They take turns choosing cards. Once a player has a set, they win.

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Let's try playing! You'll vote on where to go using the raise hand button. Click on participants and then press the hand.

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

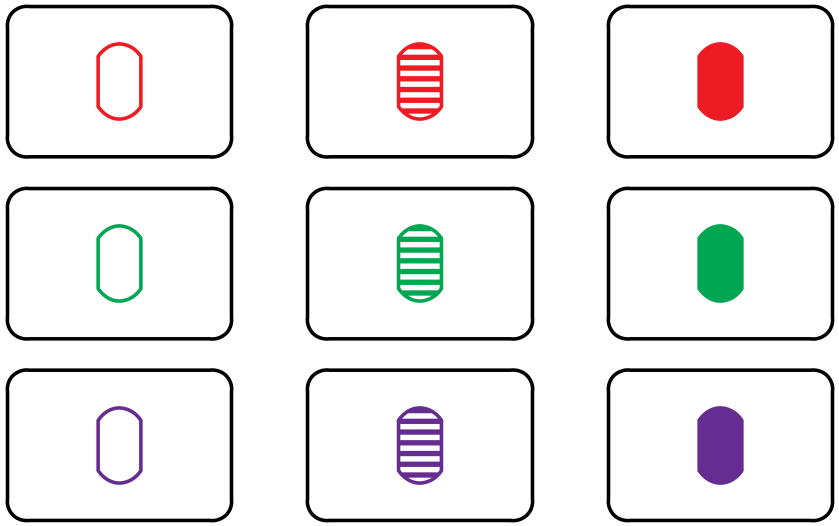
The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

We'll play with this square, but it doesn't matter which one.



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

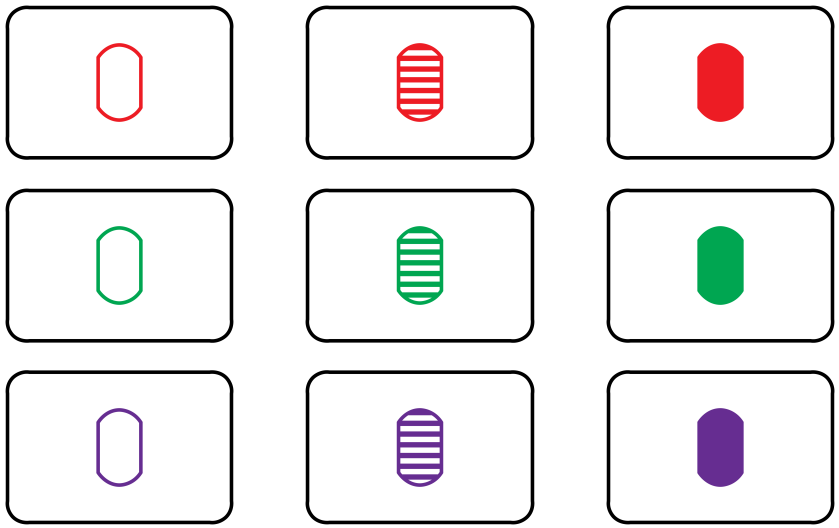
The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

You'll be X, and usually you'll vote, but this one is the same by symmetry. Let's practice voting anyway, top-middle or top-middle?



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

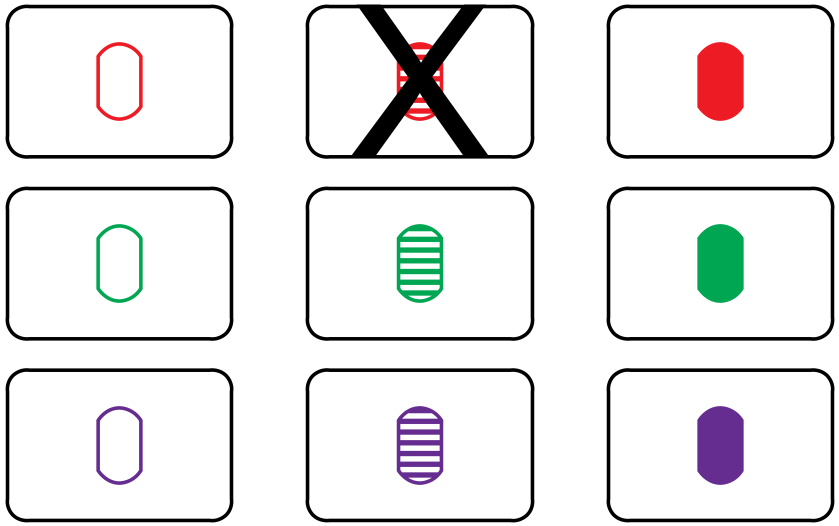
The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Oh, look! Top-middle won!



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

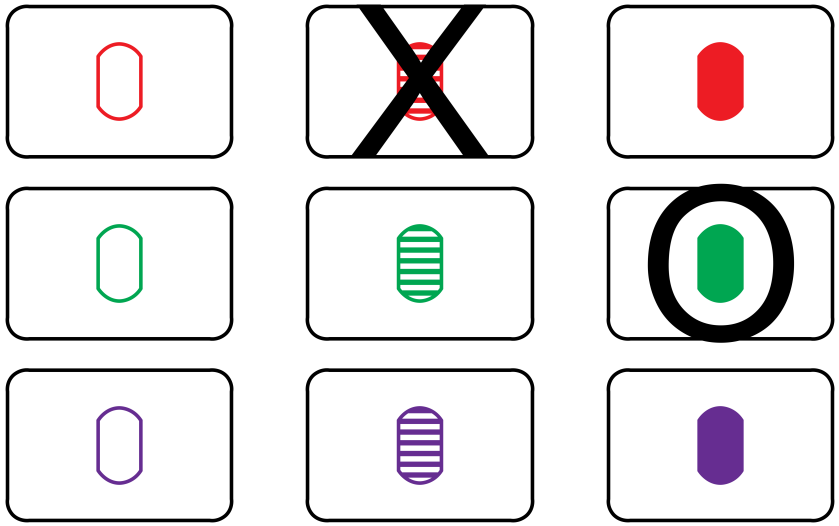
The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

O has gone, and now its your turn again. Let's vote!



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

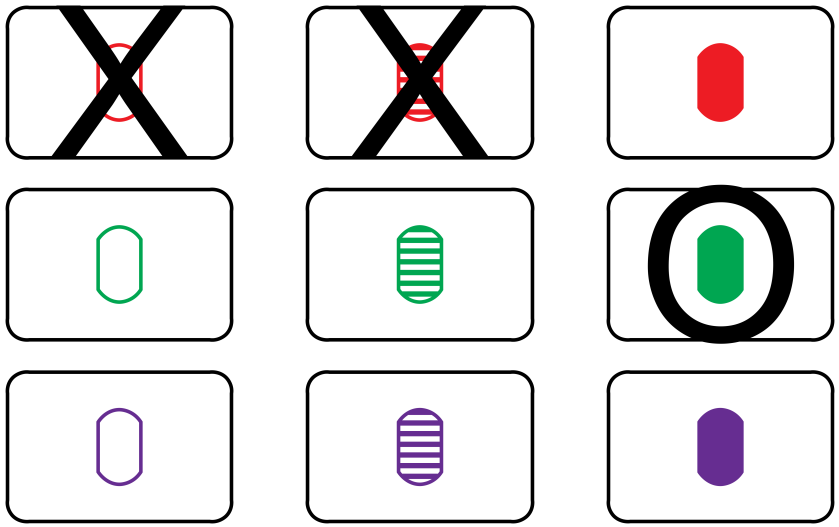
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

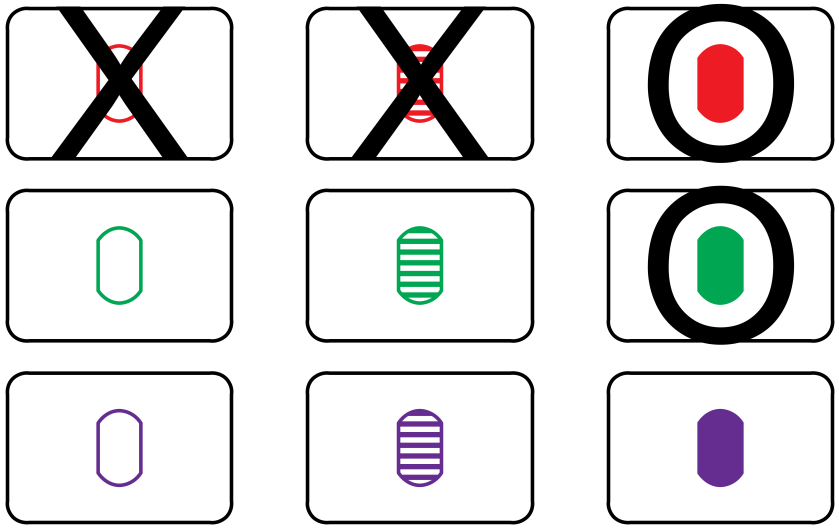
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

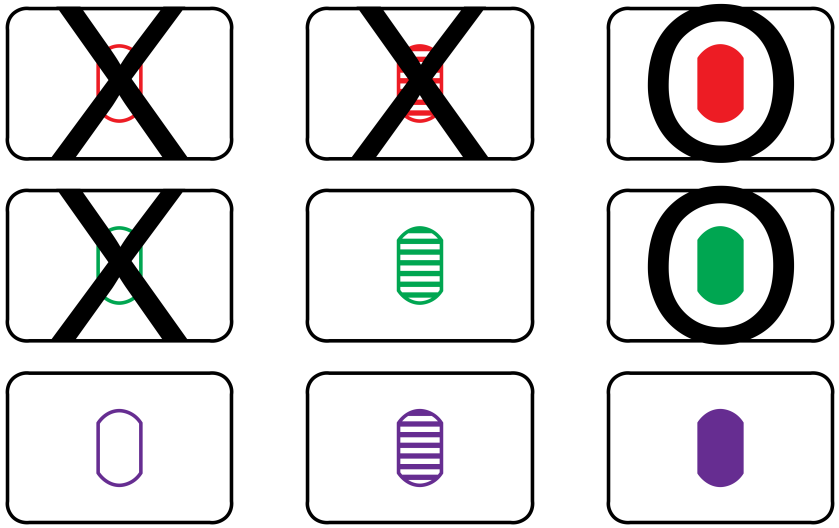
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

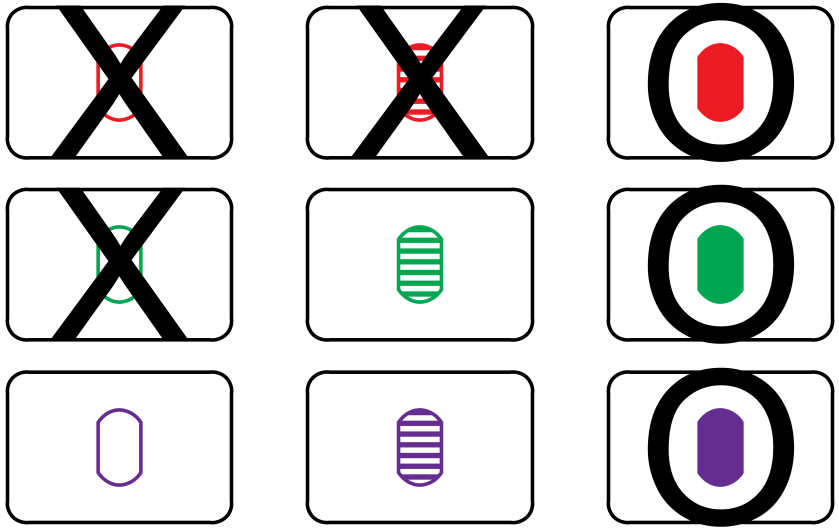
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

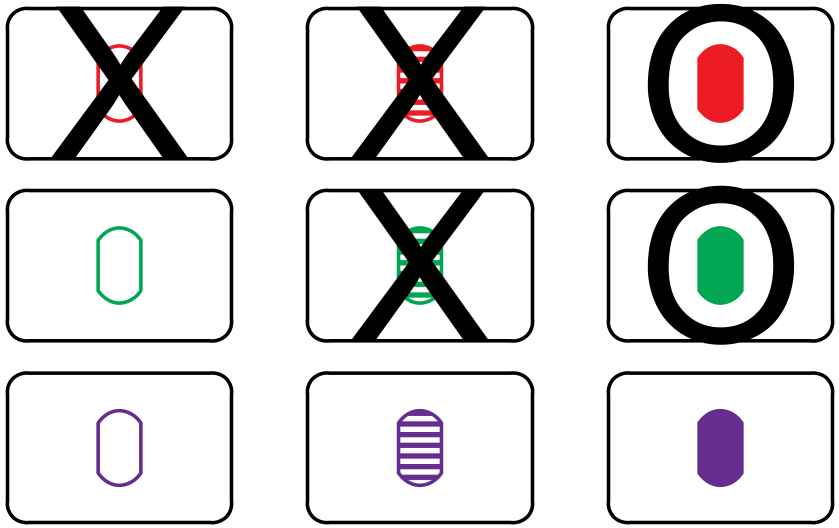
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

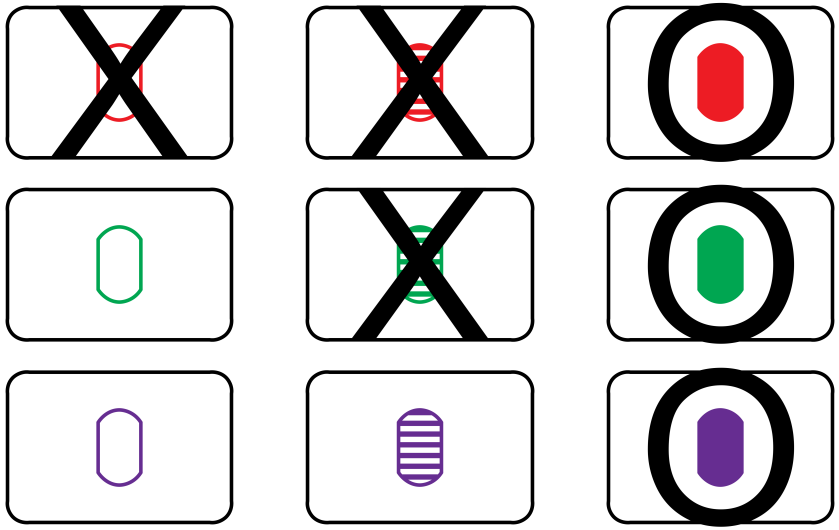
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

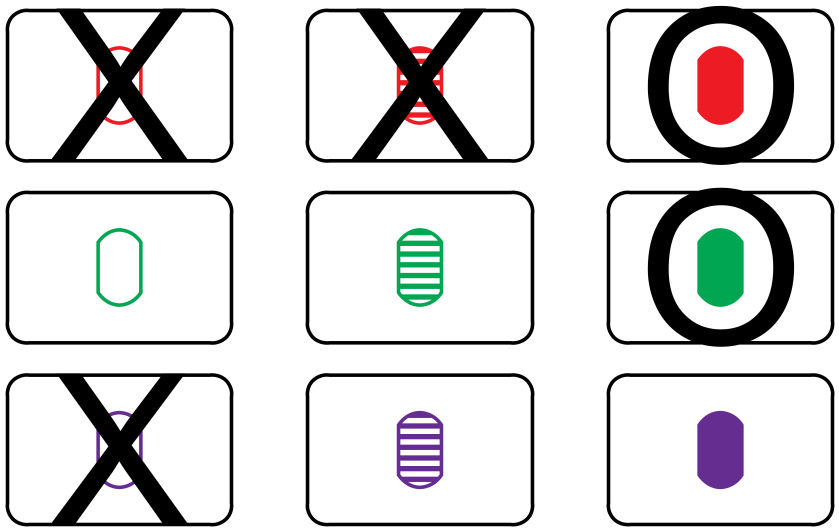
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

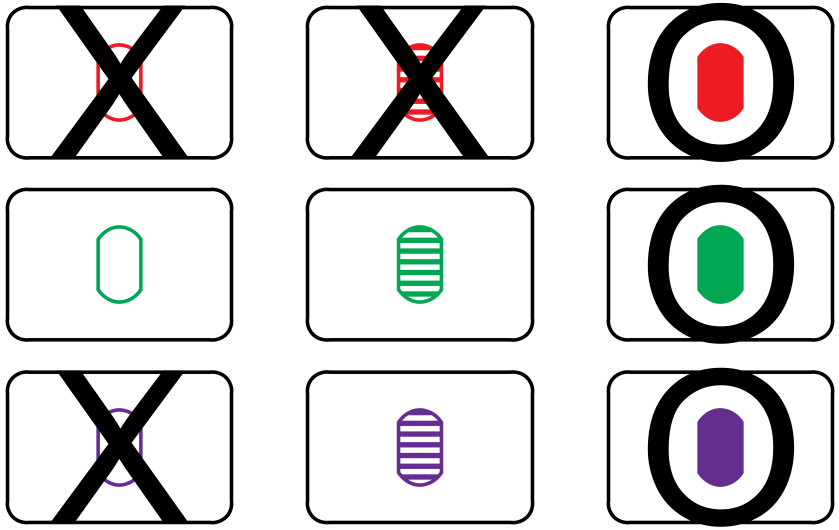
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

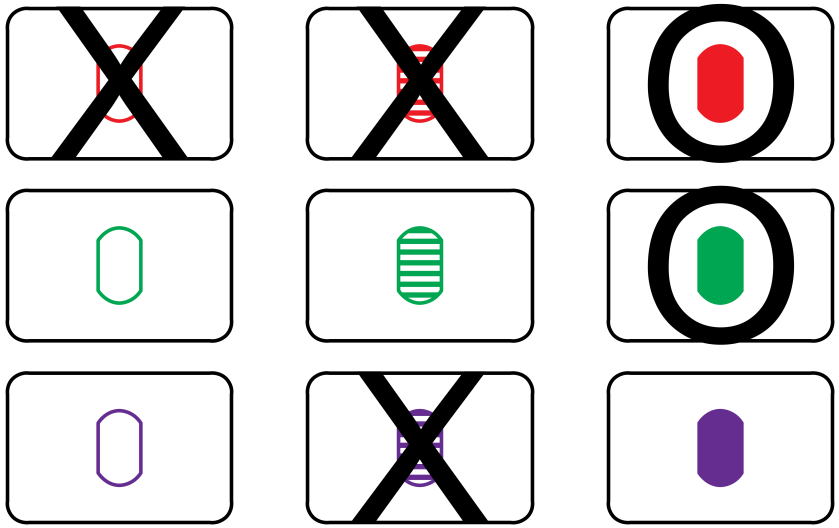
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

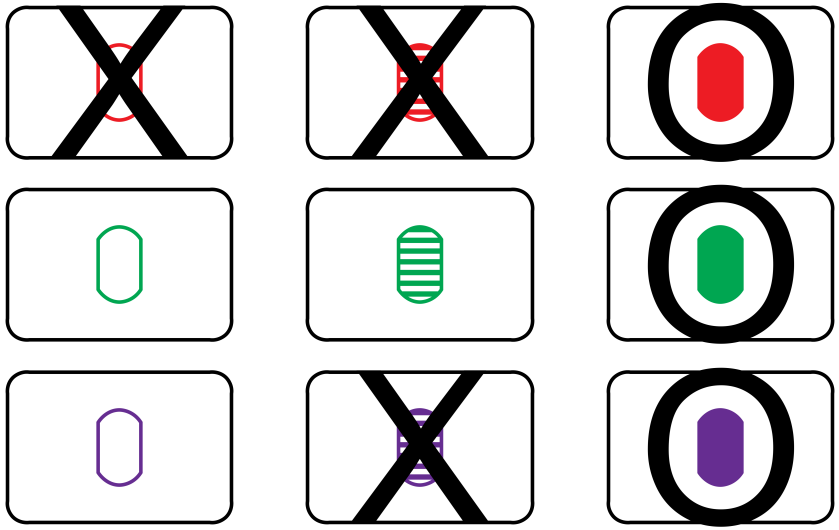
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

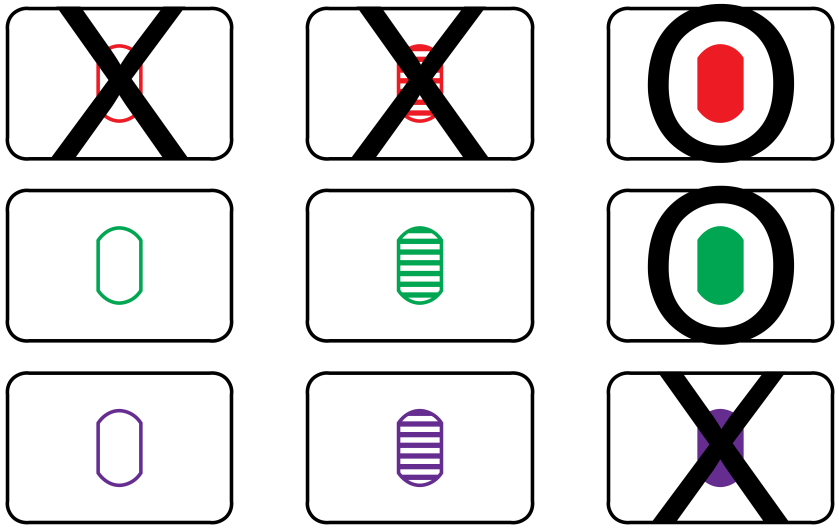
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

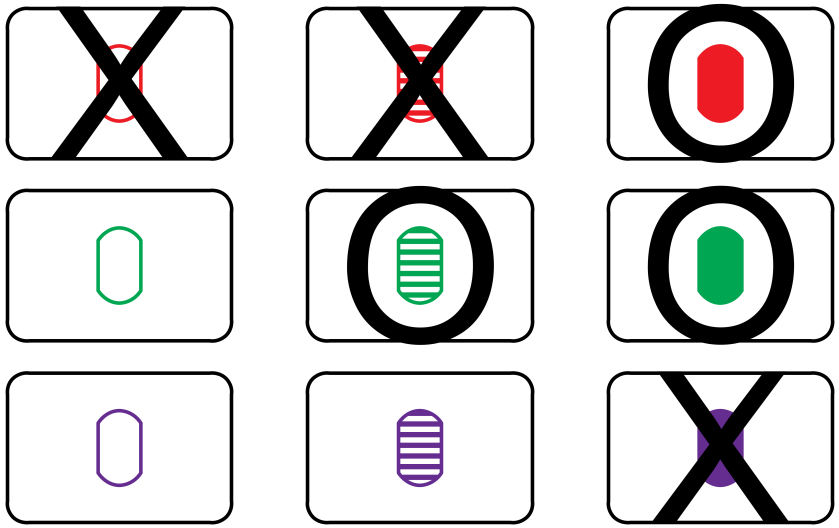
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

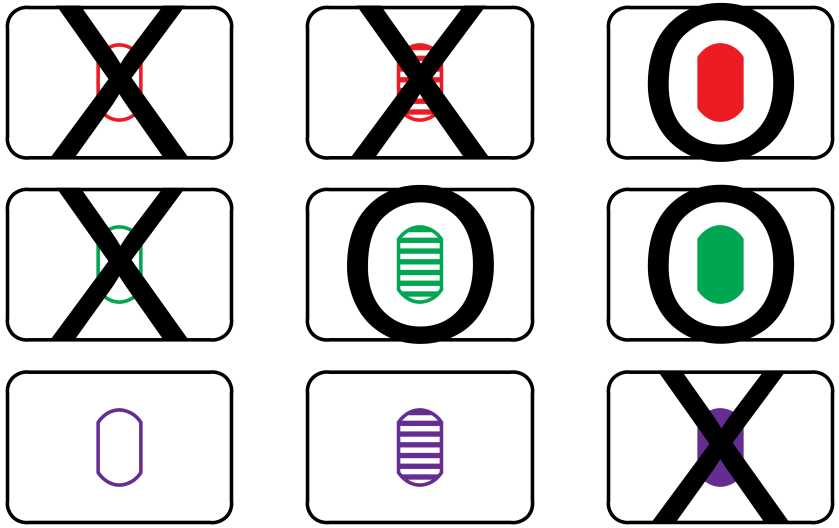
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



X wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

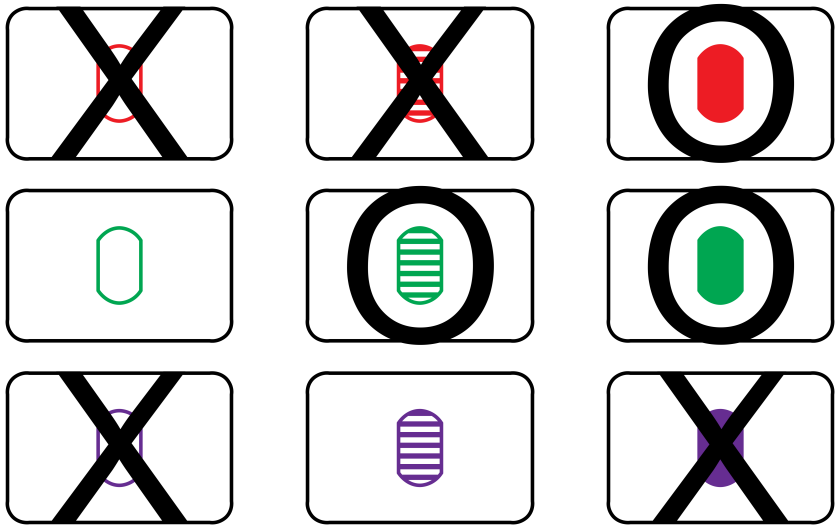
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

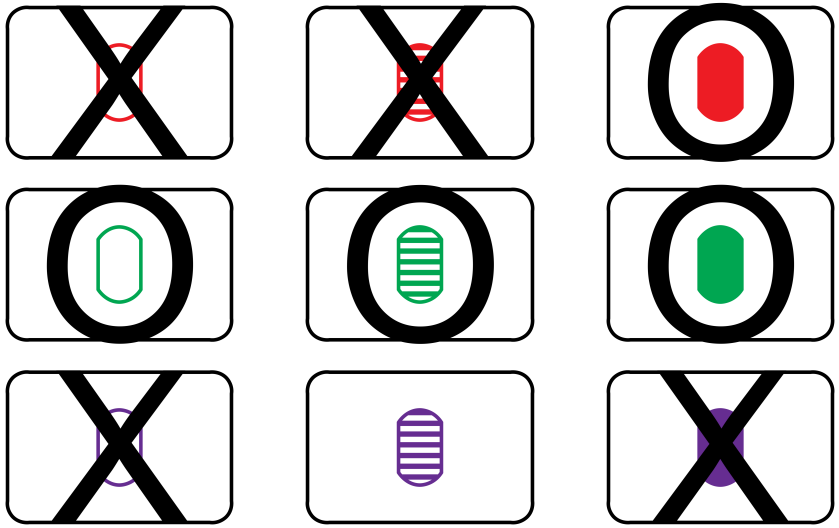
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

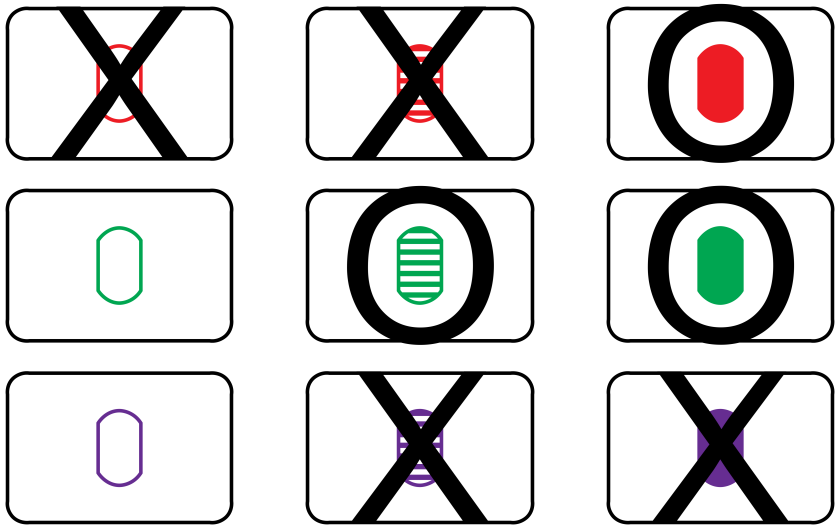
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

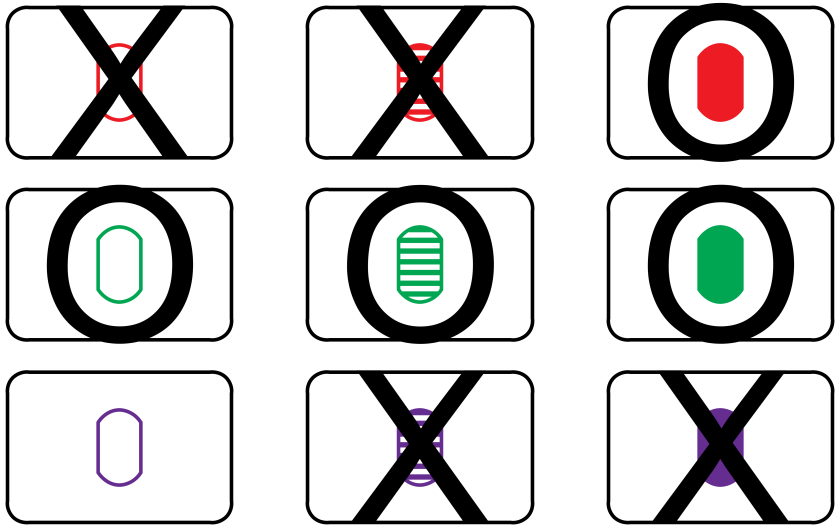
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

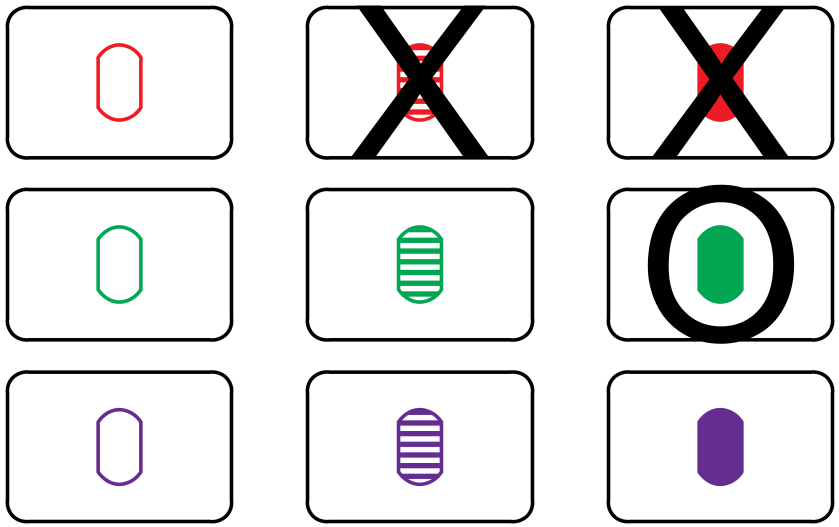
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

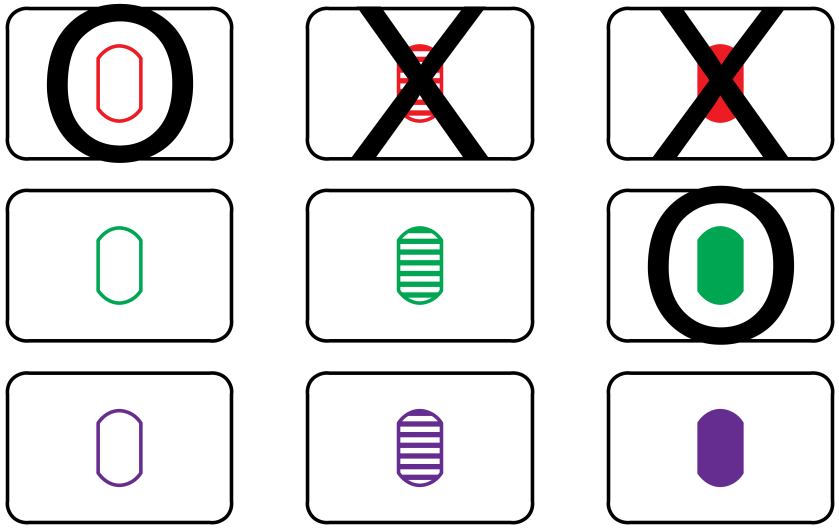
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

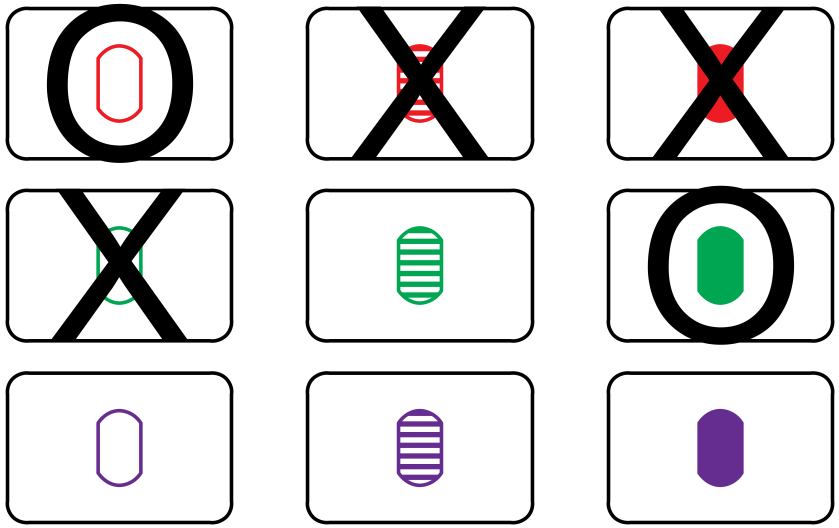
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

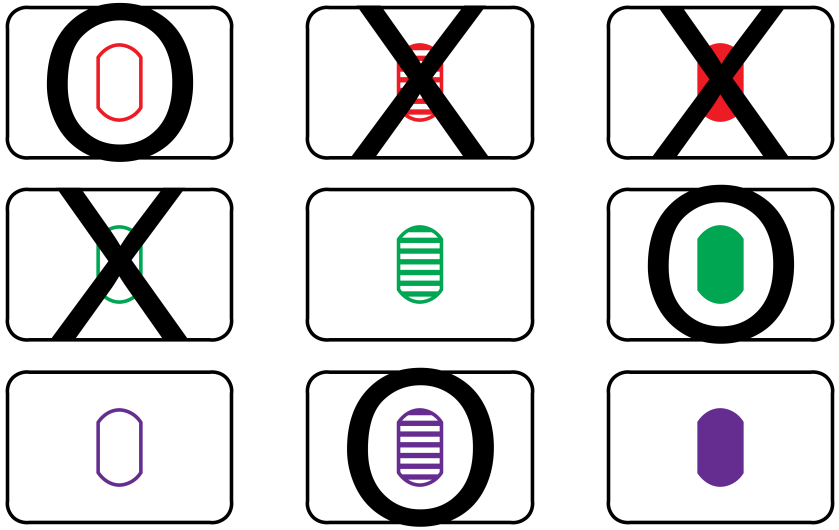
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

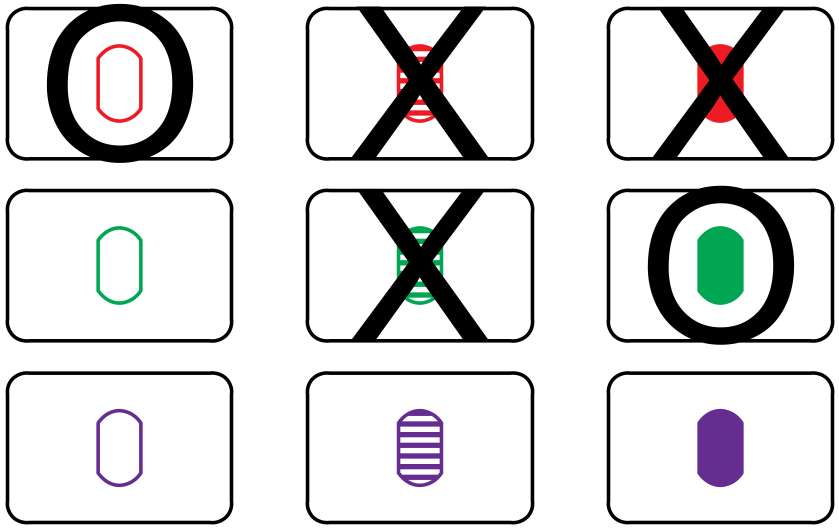
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

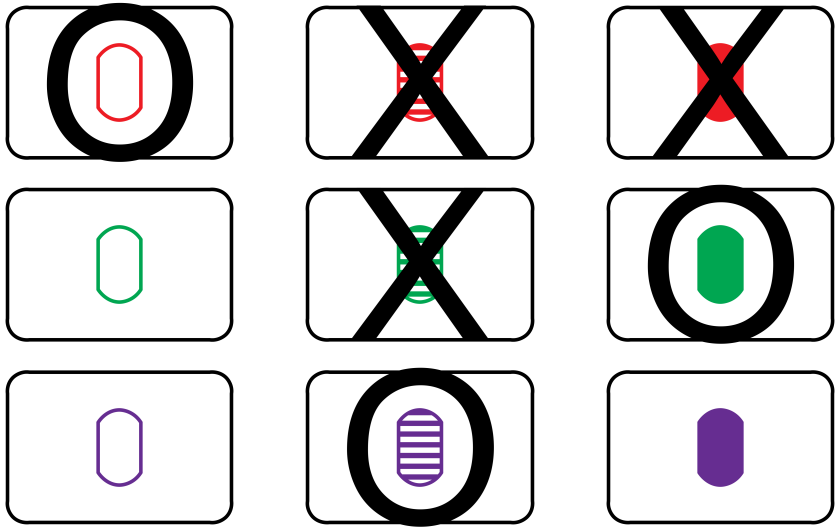
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

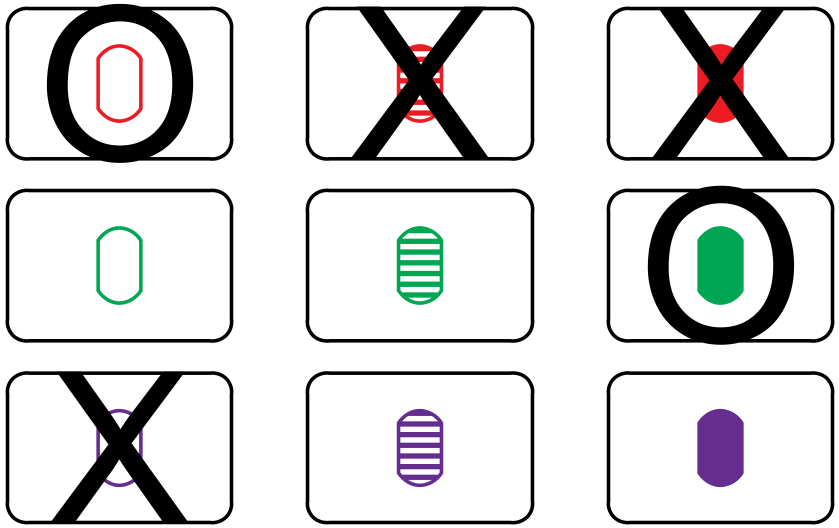
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

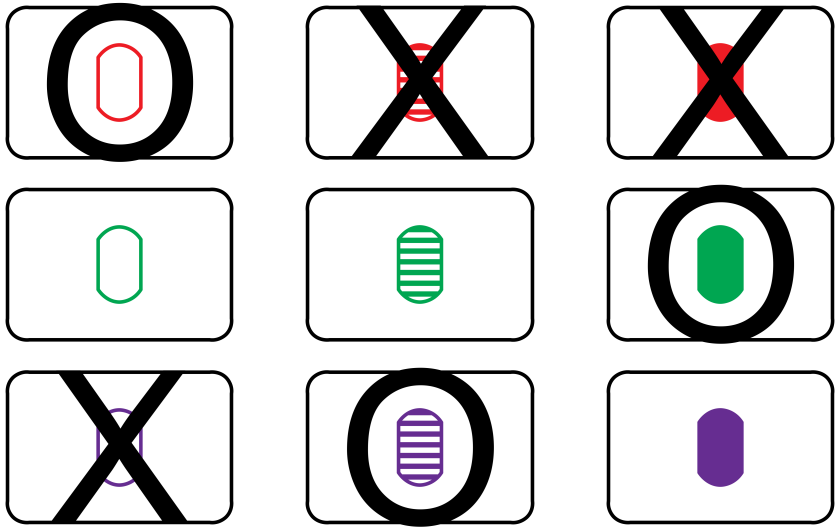
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

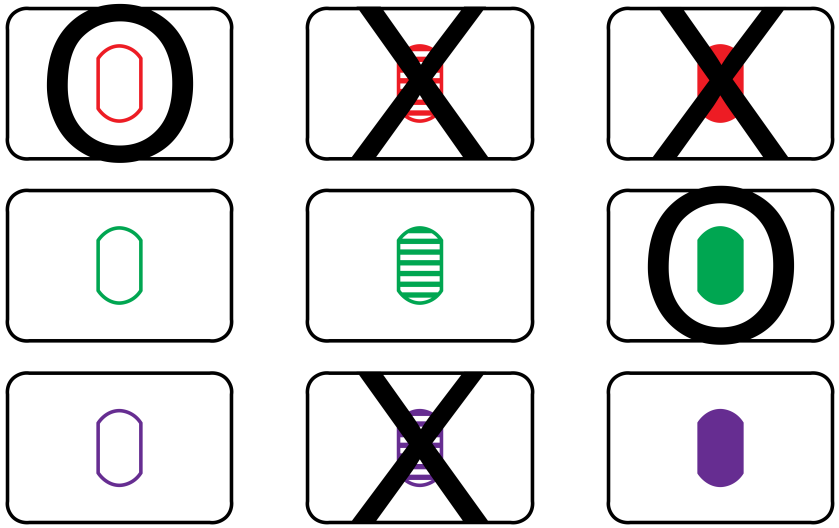
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

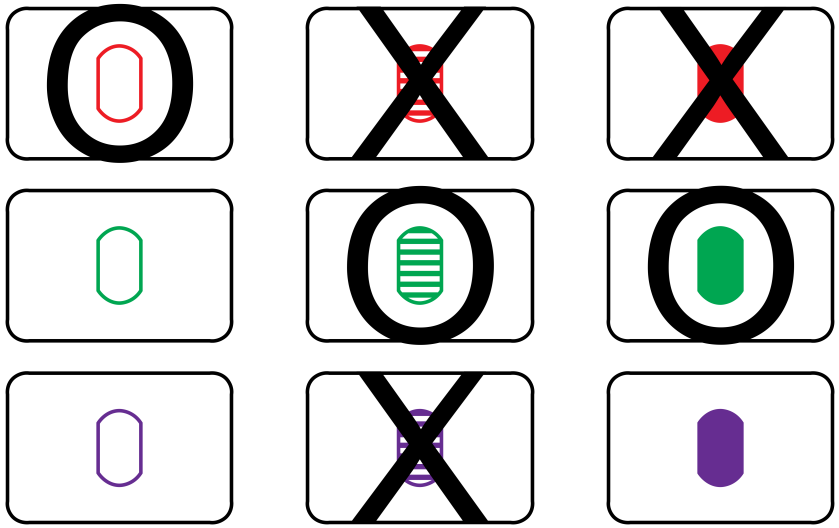
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

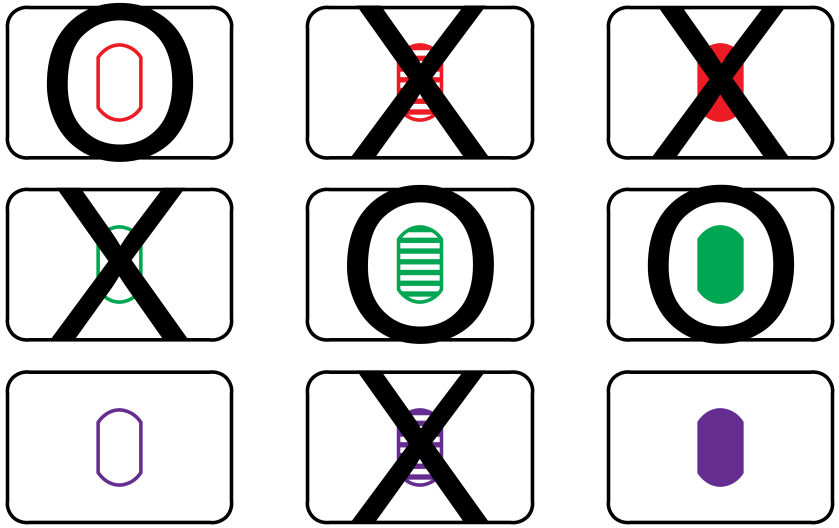
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



X wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

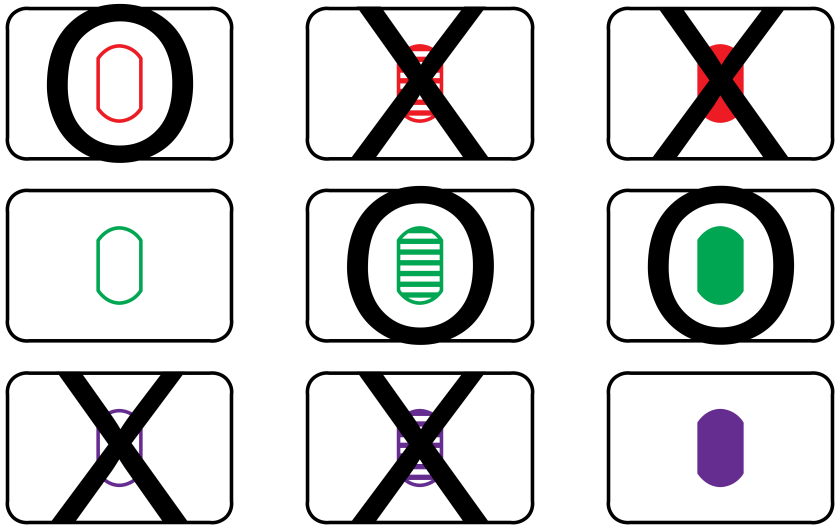
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

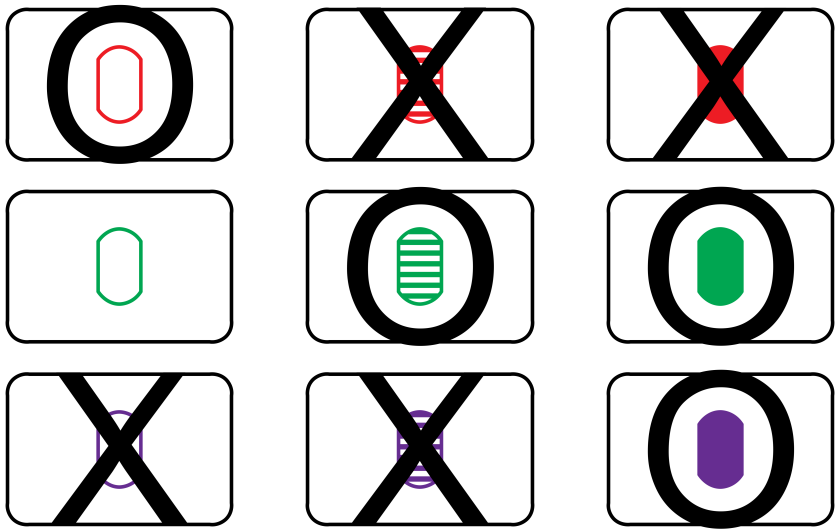
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

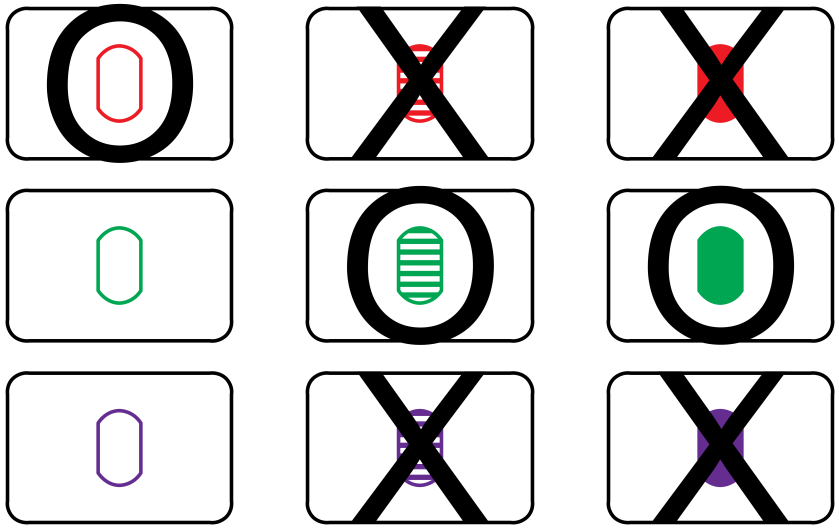
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

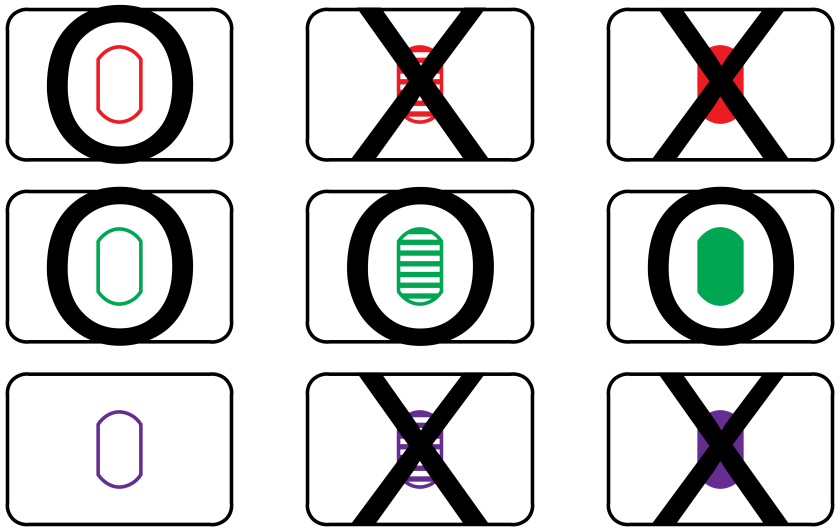
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

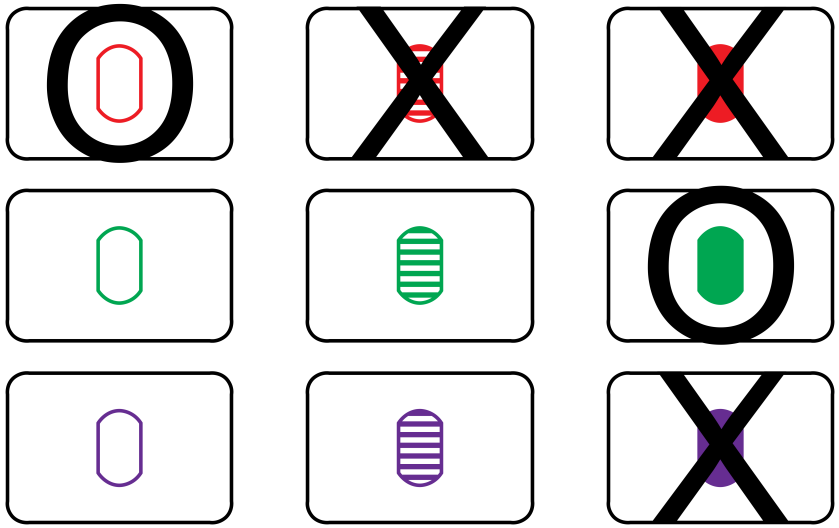
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

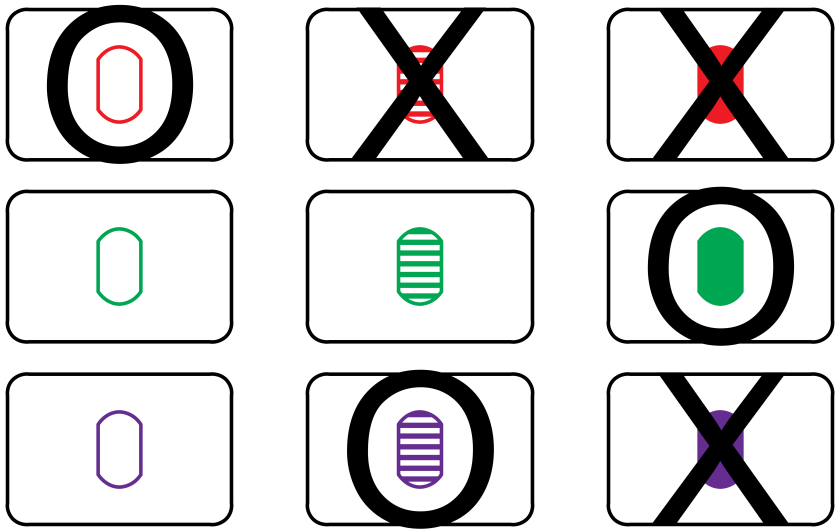
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

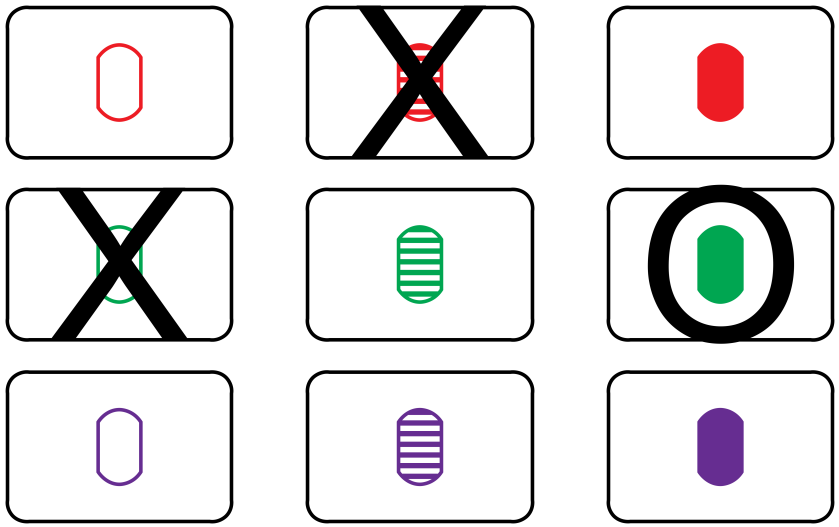
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

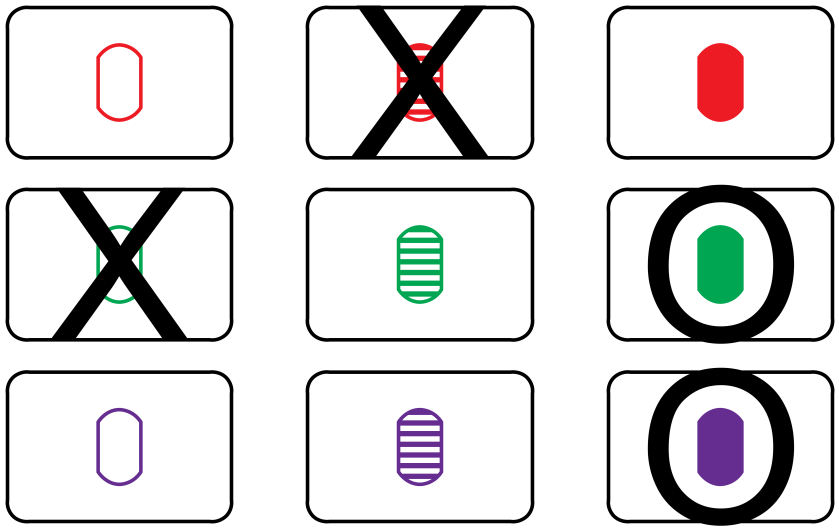
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

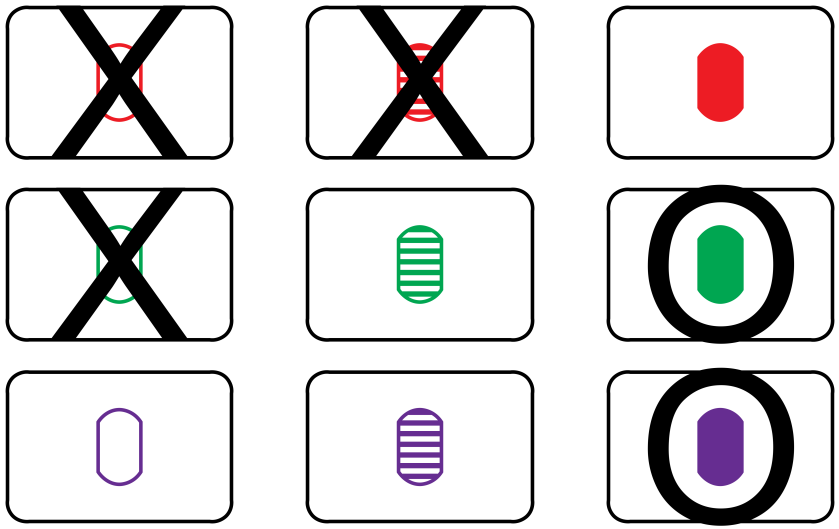
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

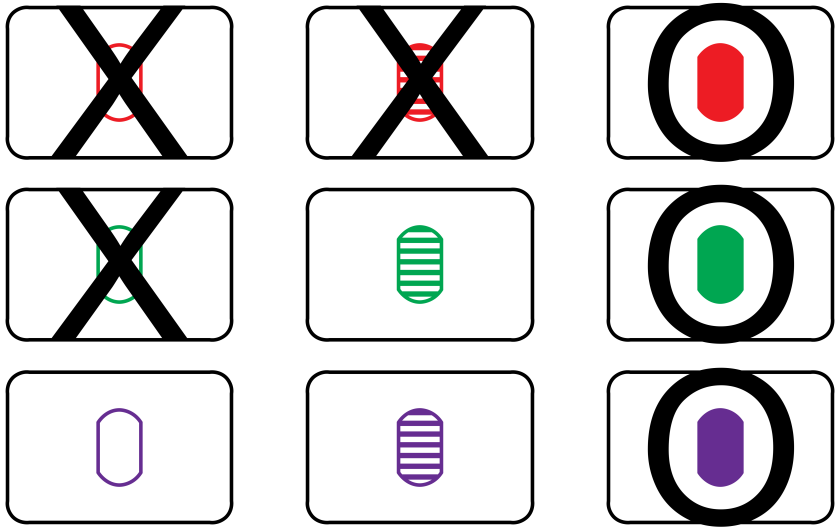
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

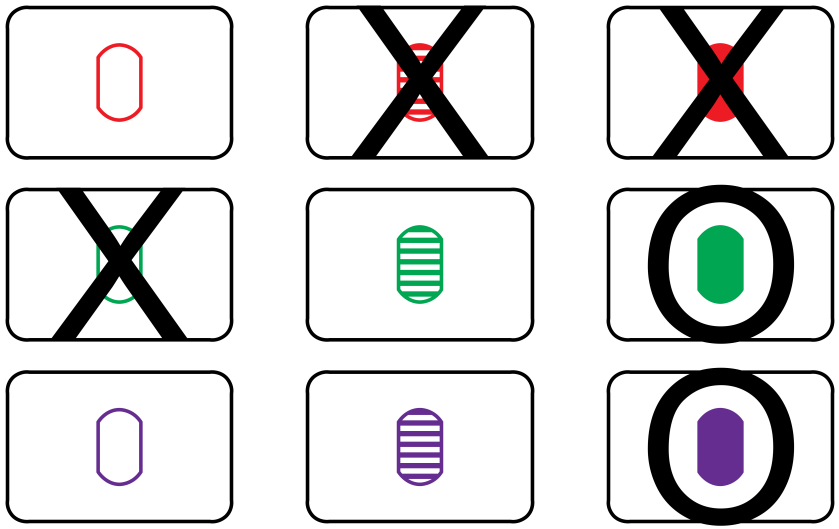
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

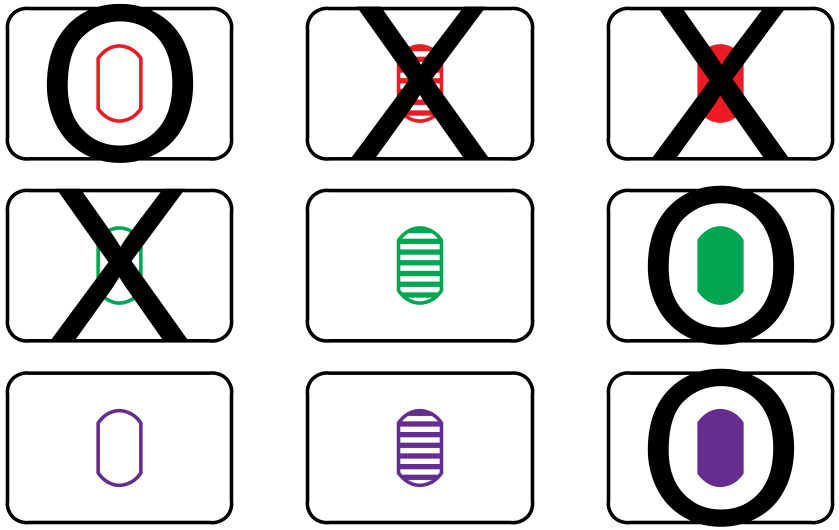
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

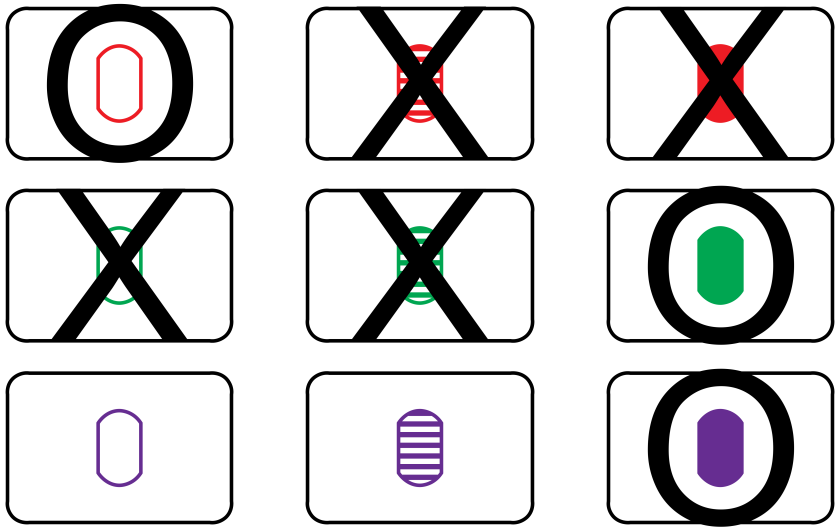
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

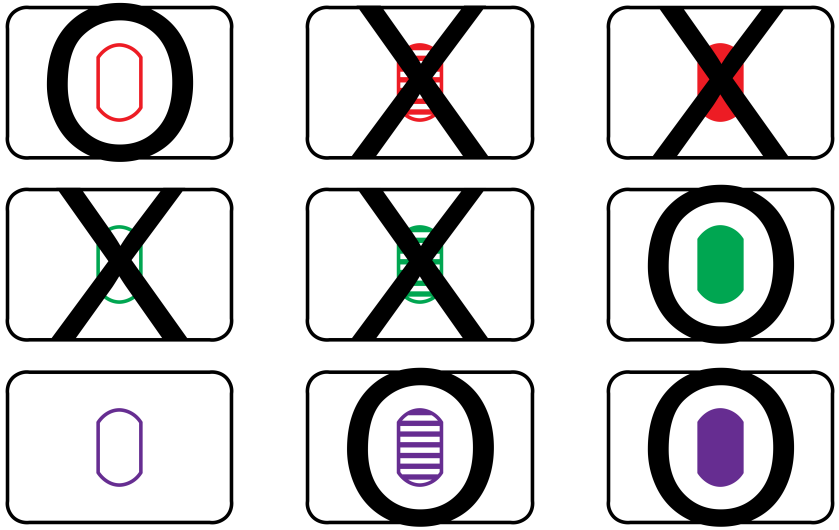
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

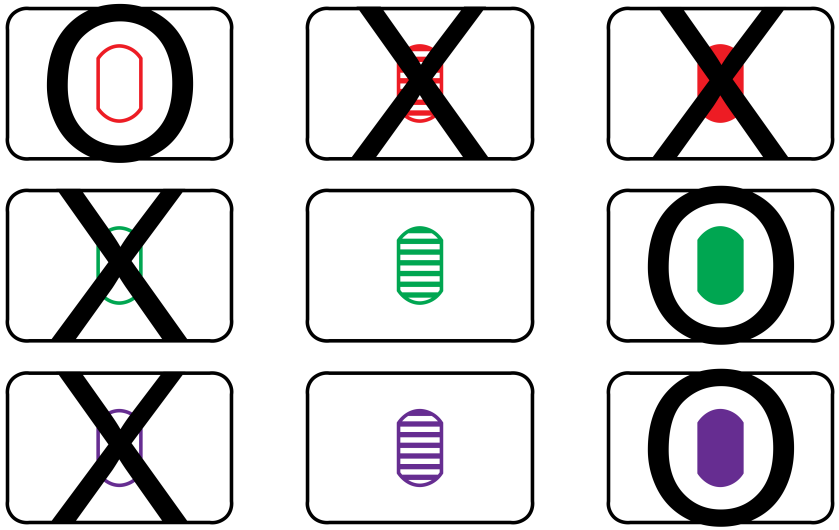
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

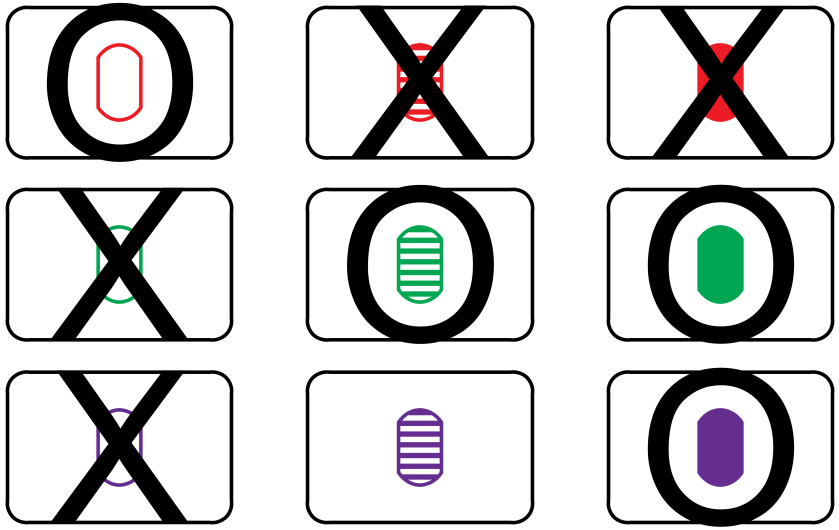
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

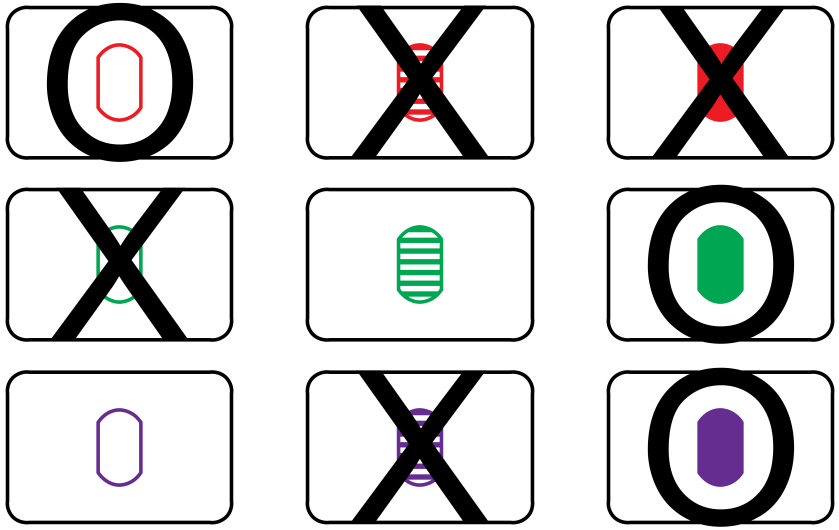
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



X wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

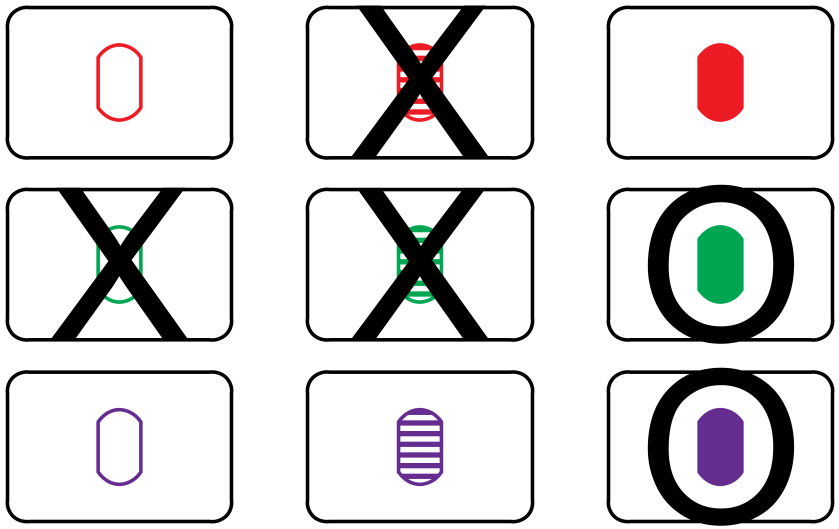
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

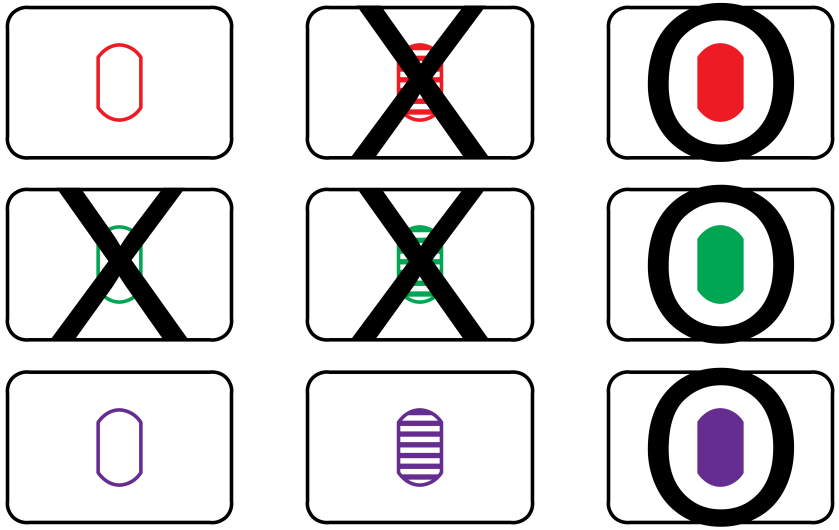
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

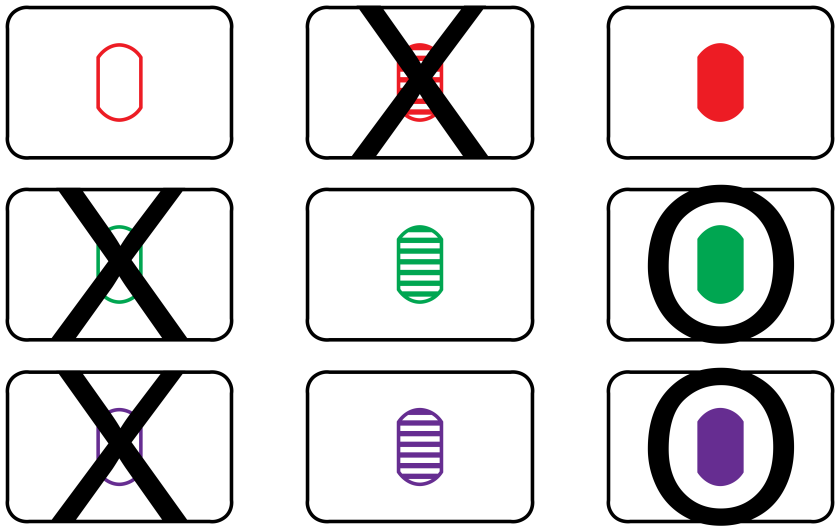
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

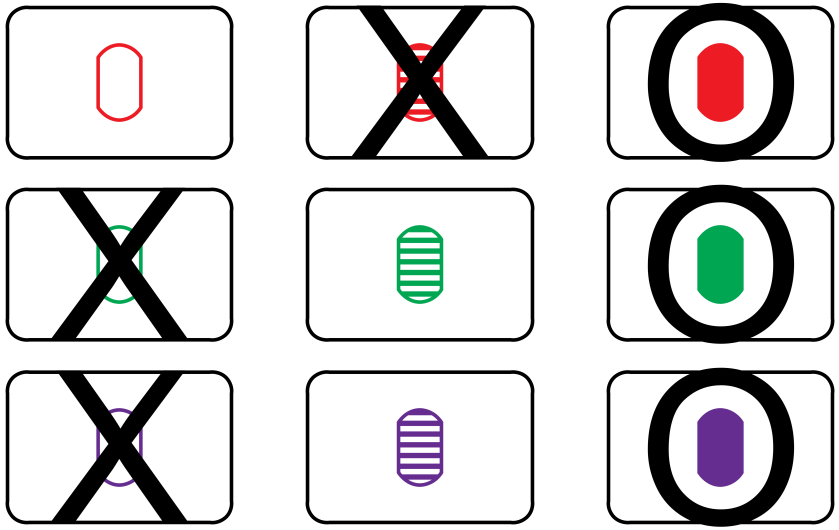
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

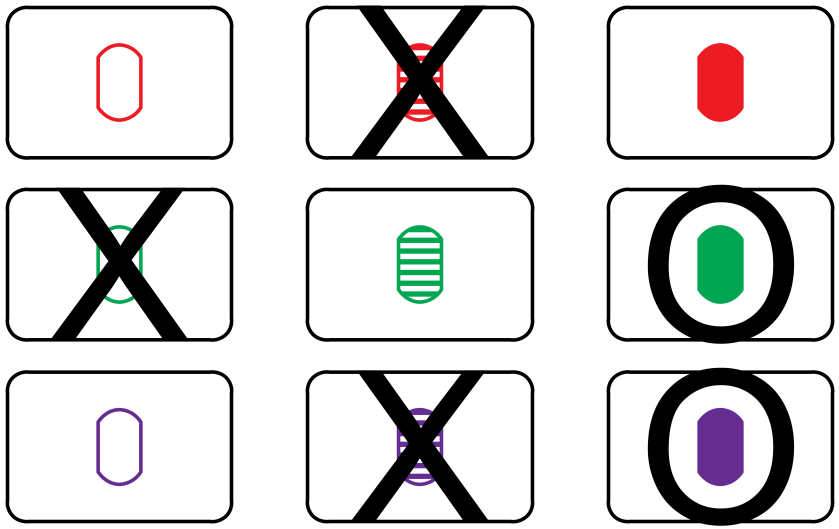
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

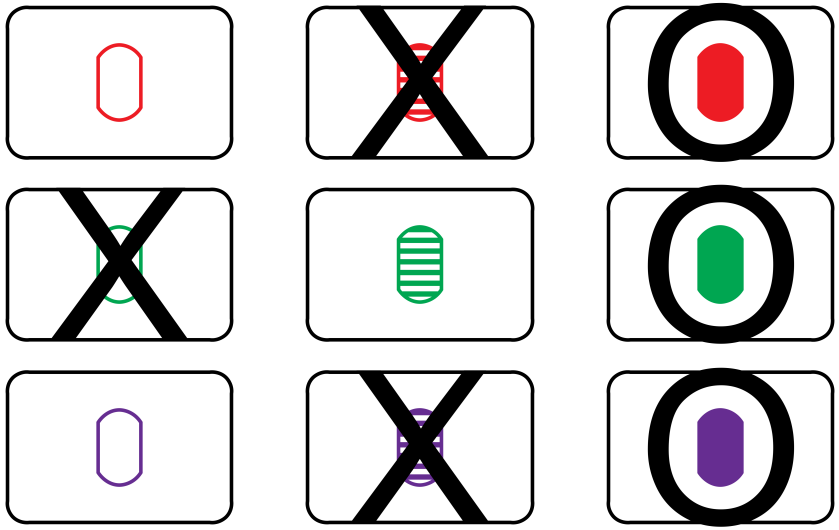
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

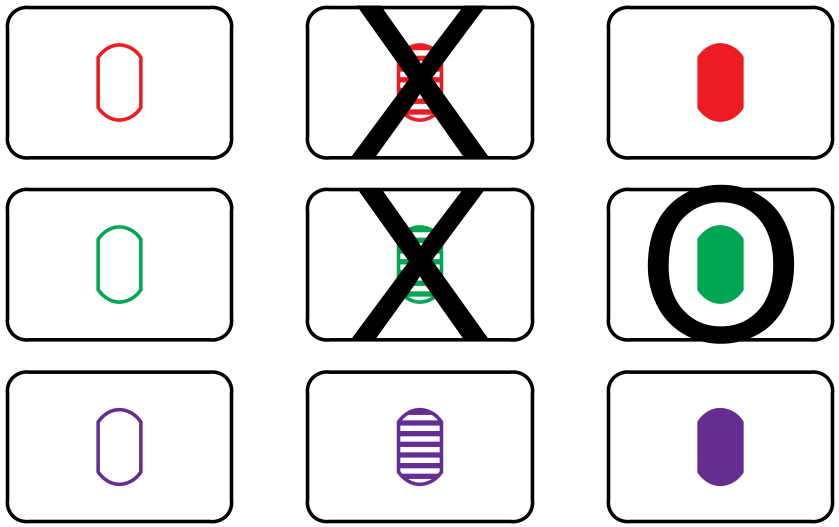
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

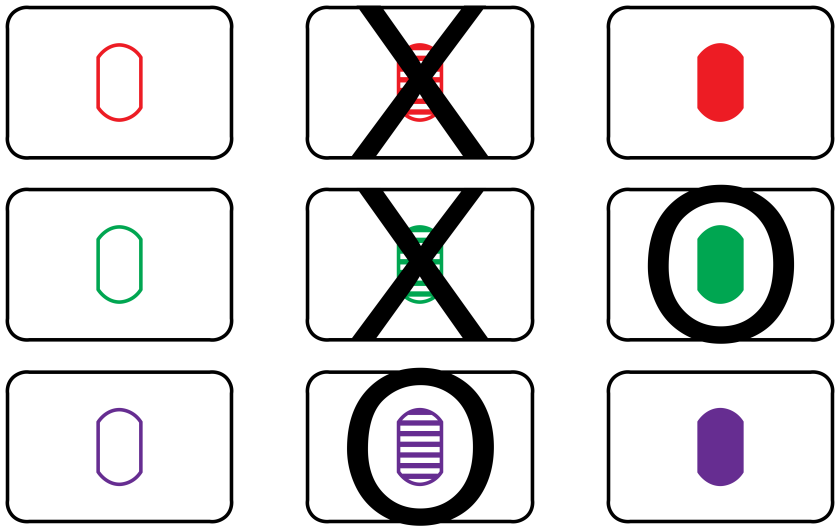
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

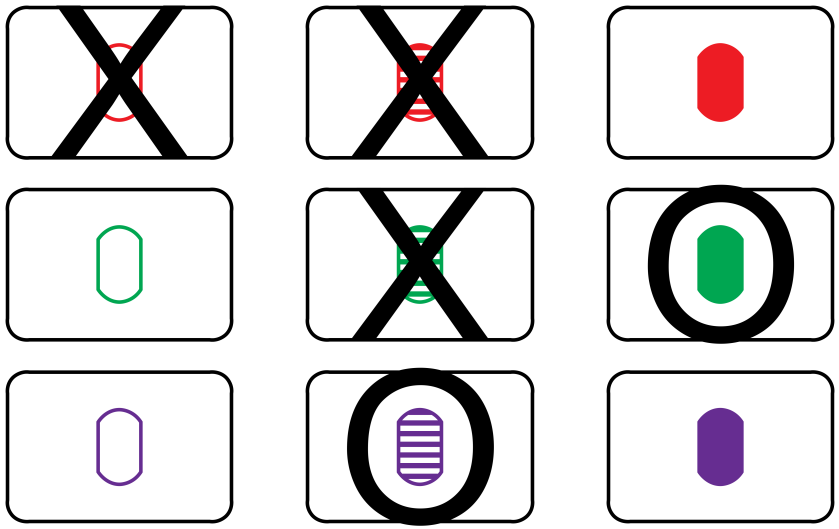
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

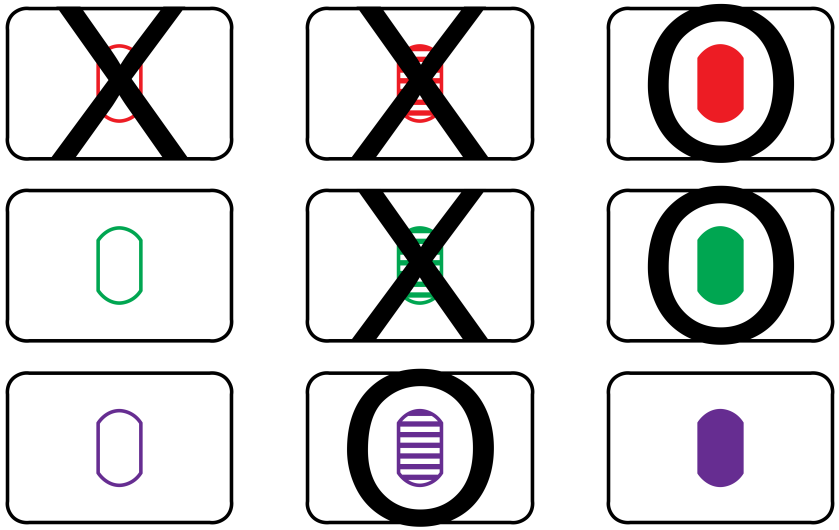
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

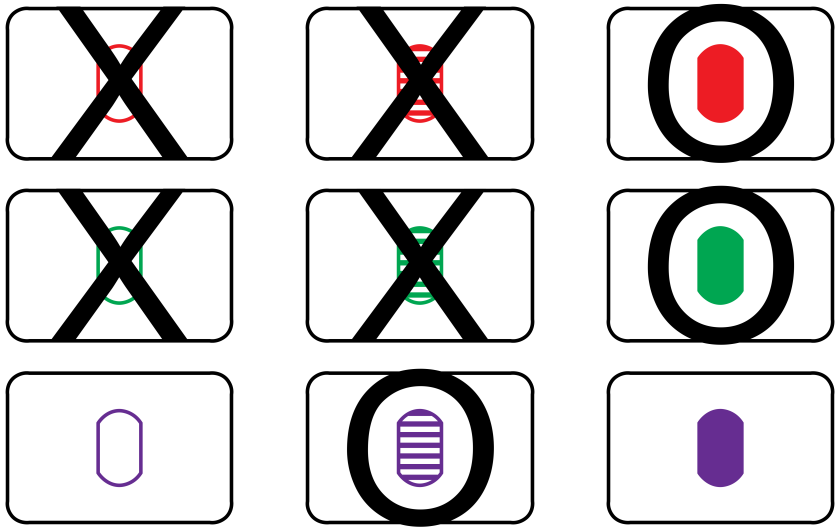
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

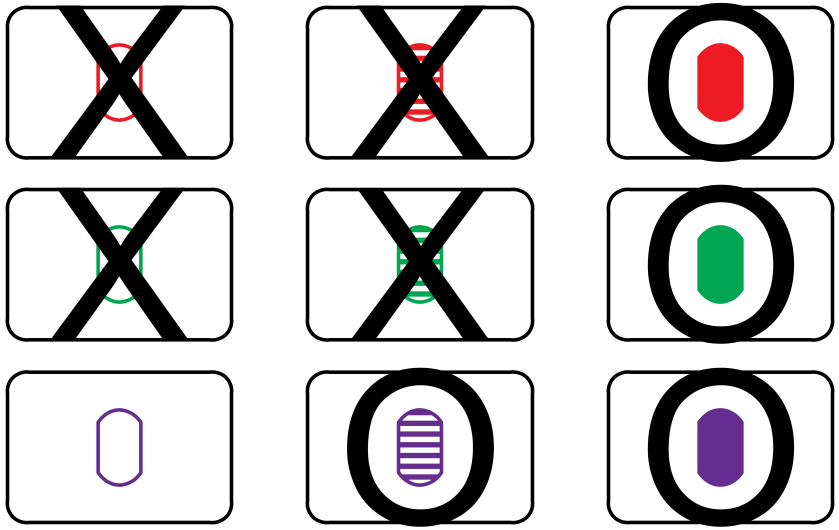
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

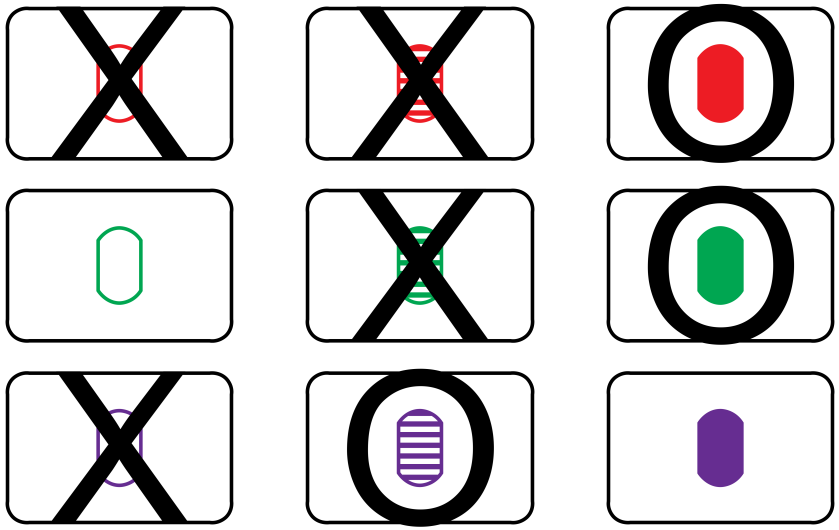
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

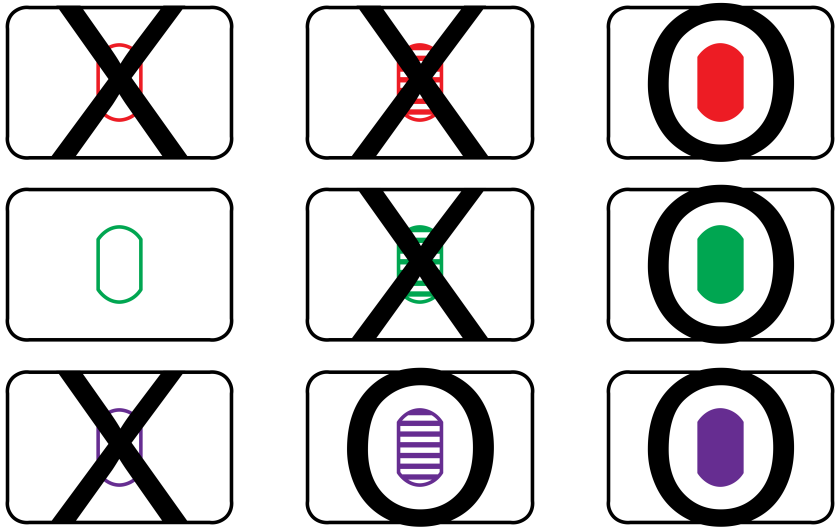
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

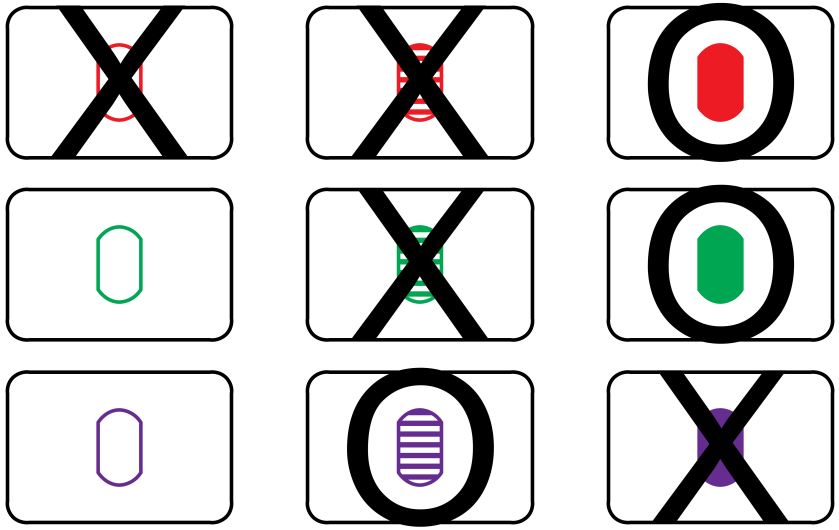
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



X wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

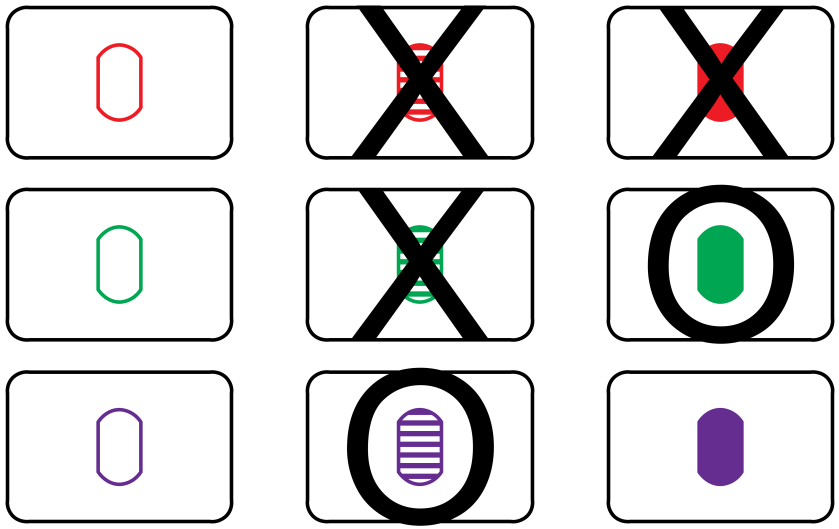
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

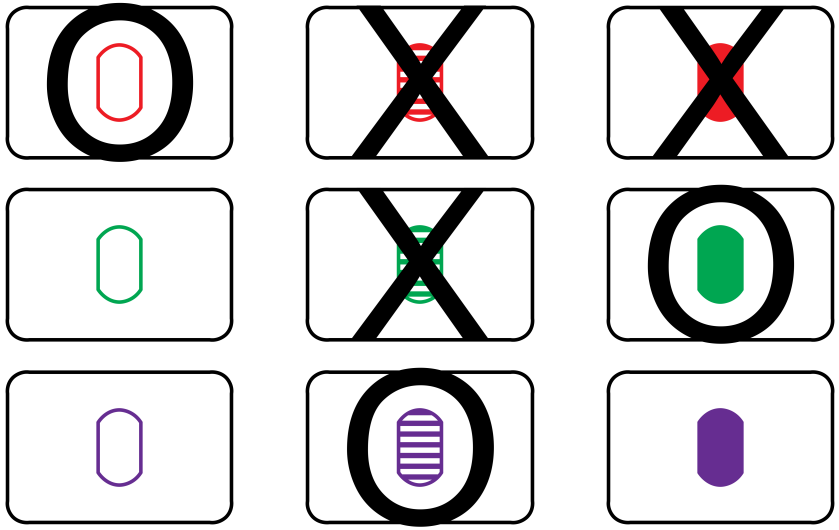
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

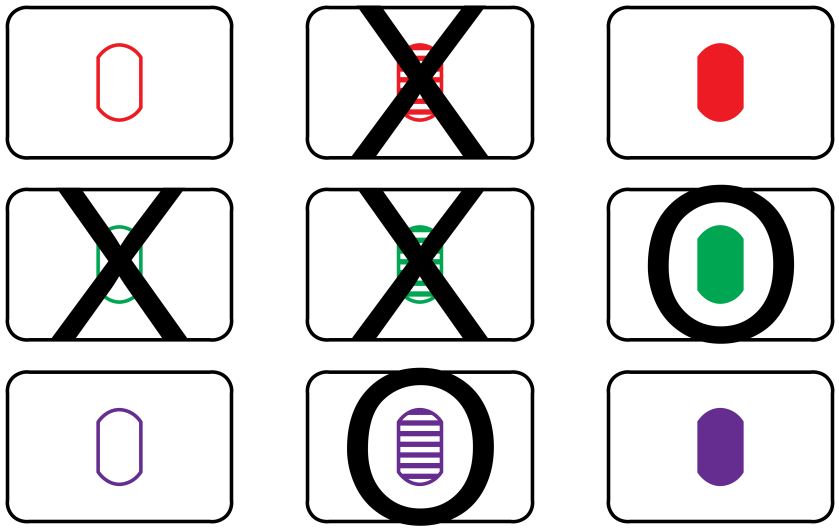
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

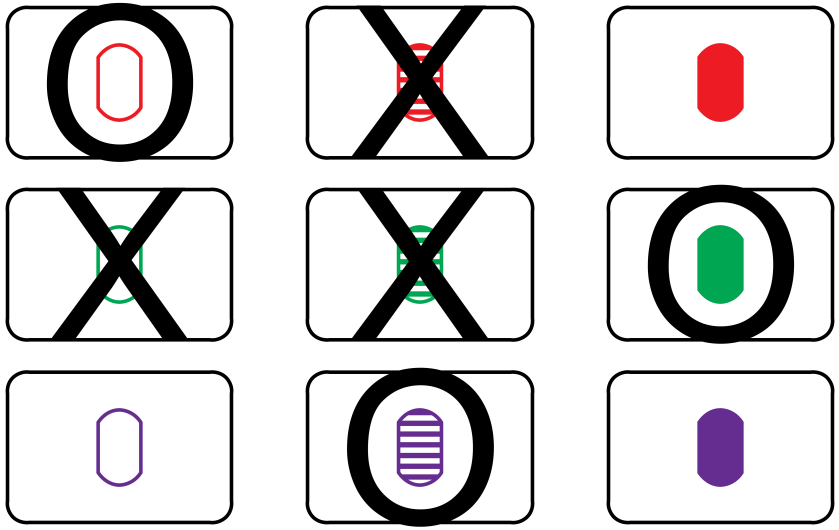
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

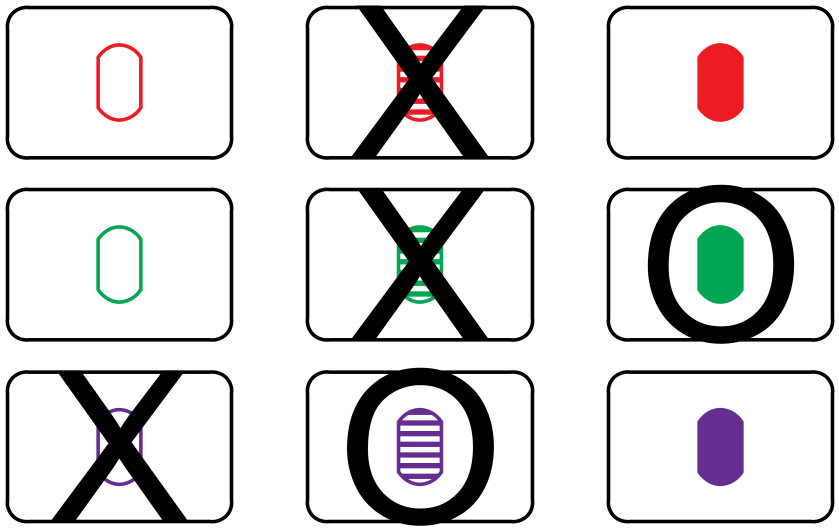
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

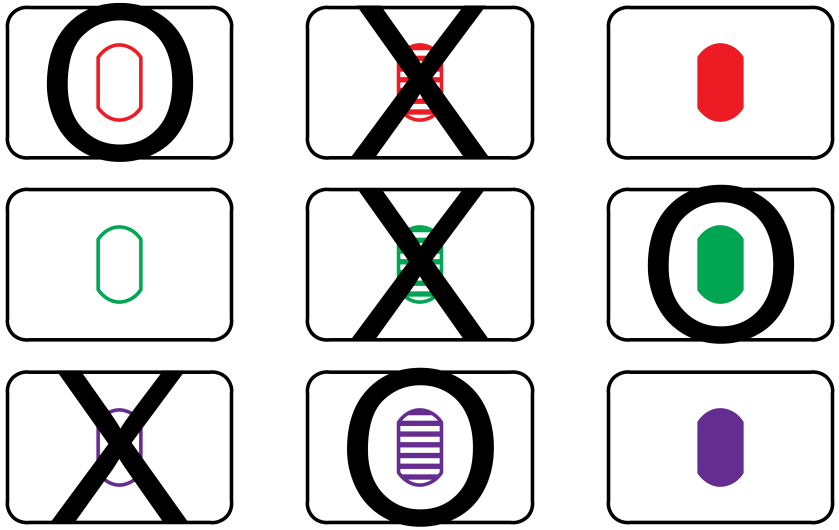
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

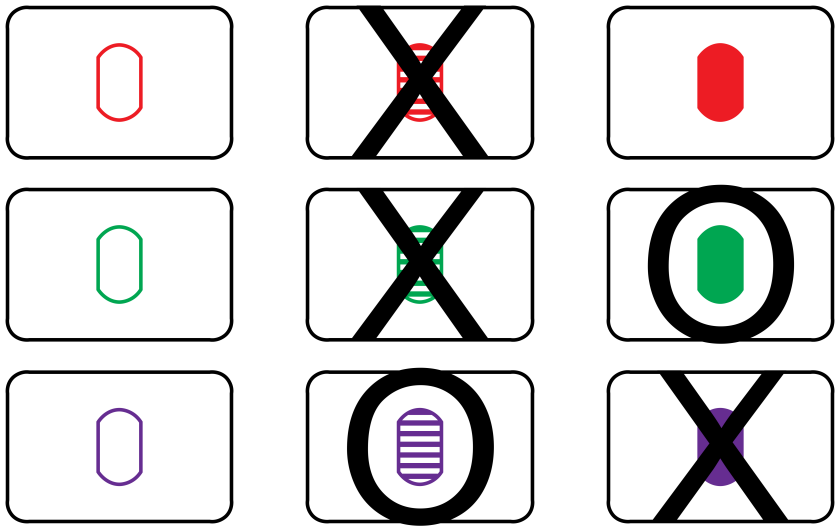
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

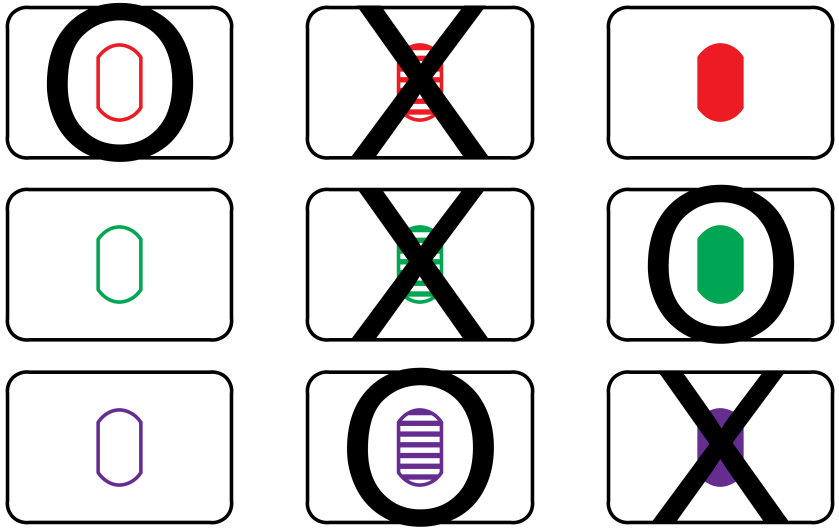
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

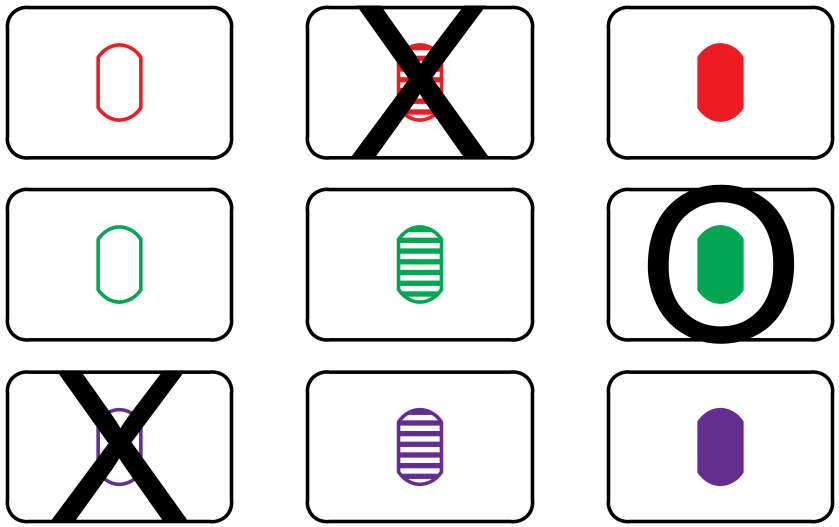
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

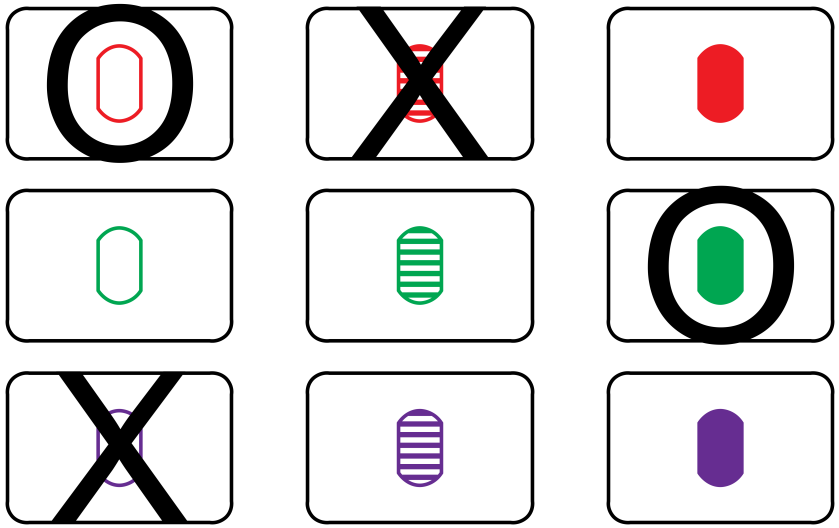
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

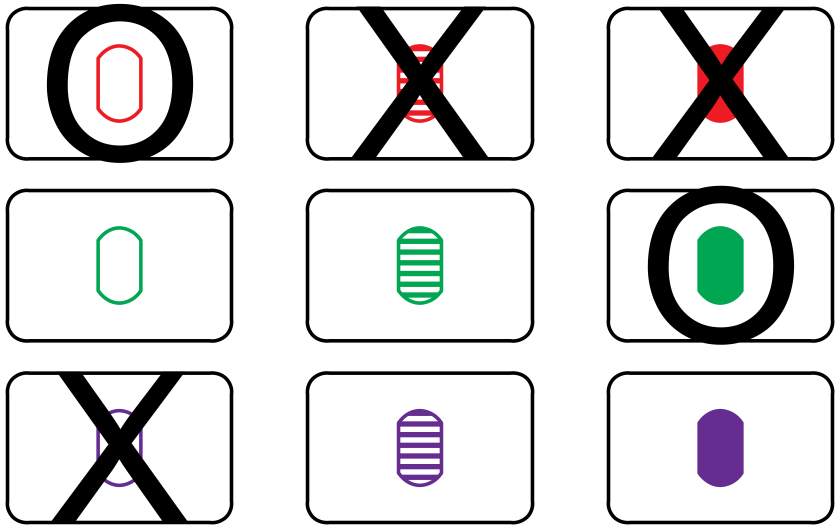
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

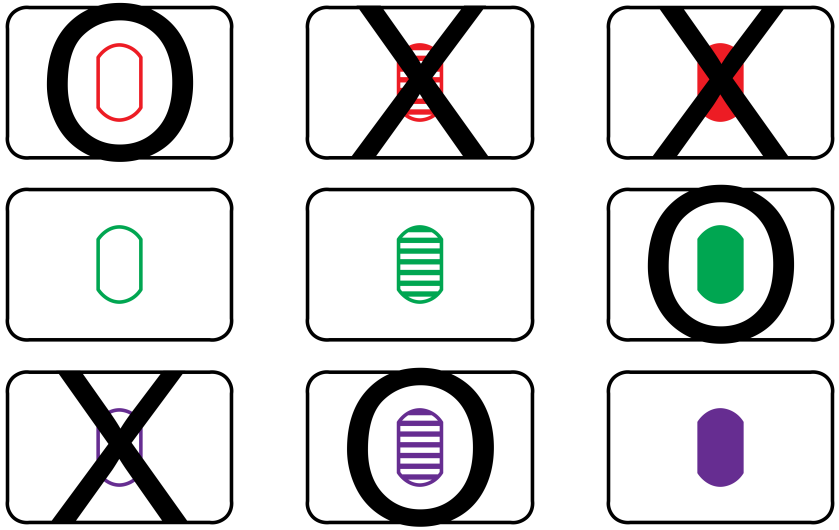
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

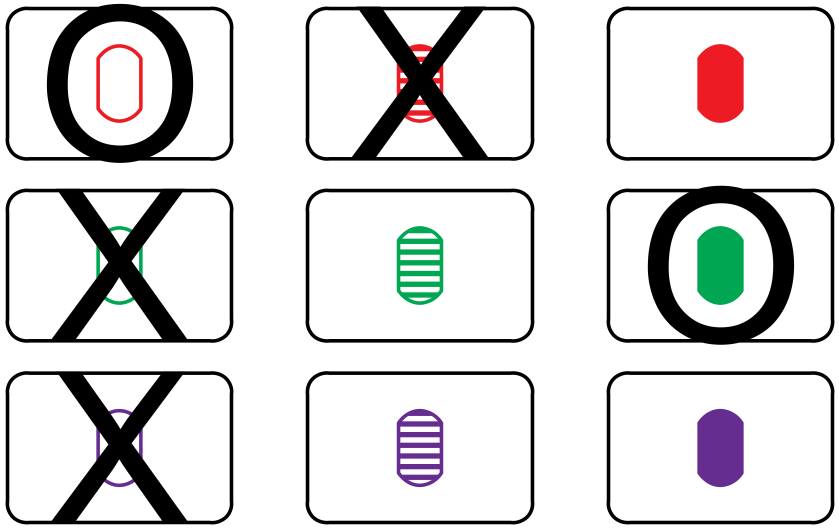
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

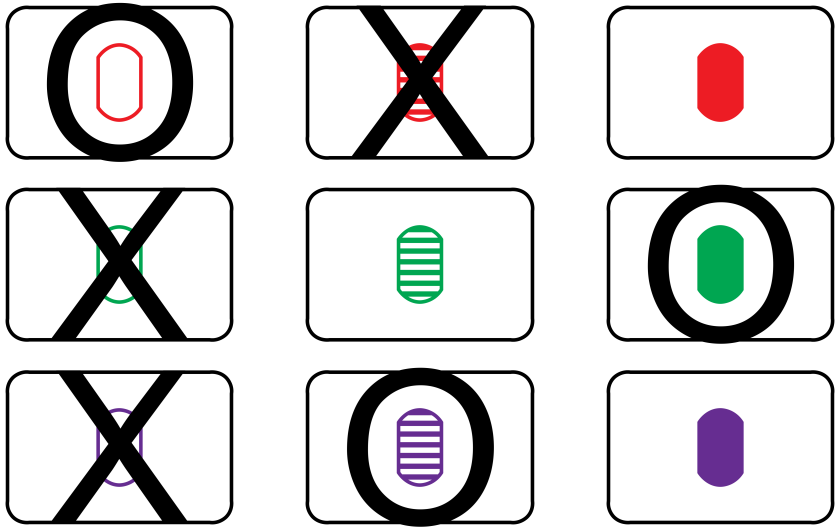
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

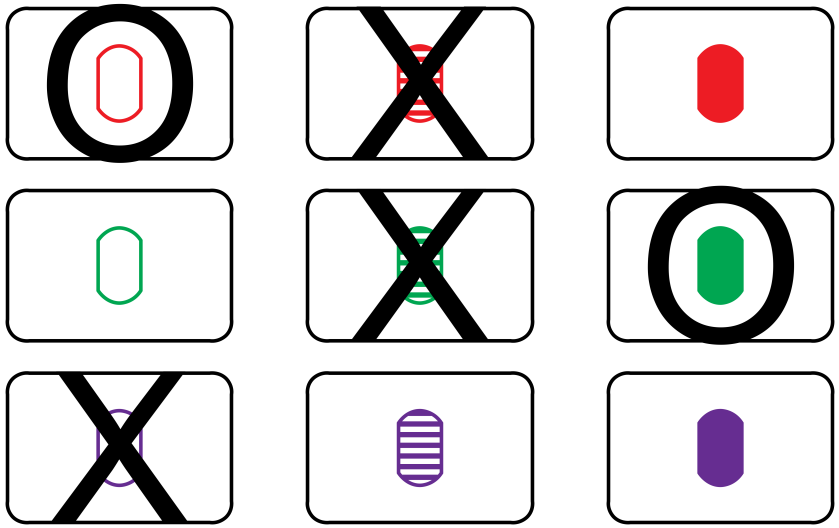
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

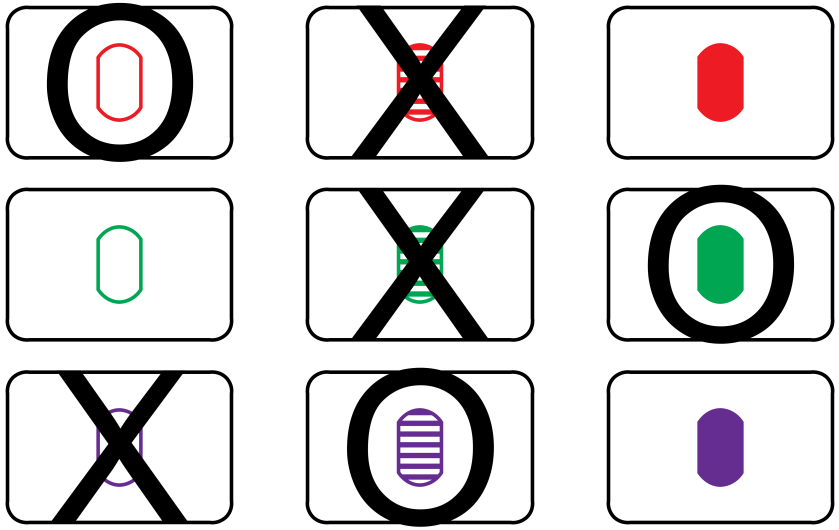
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

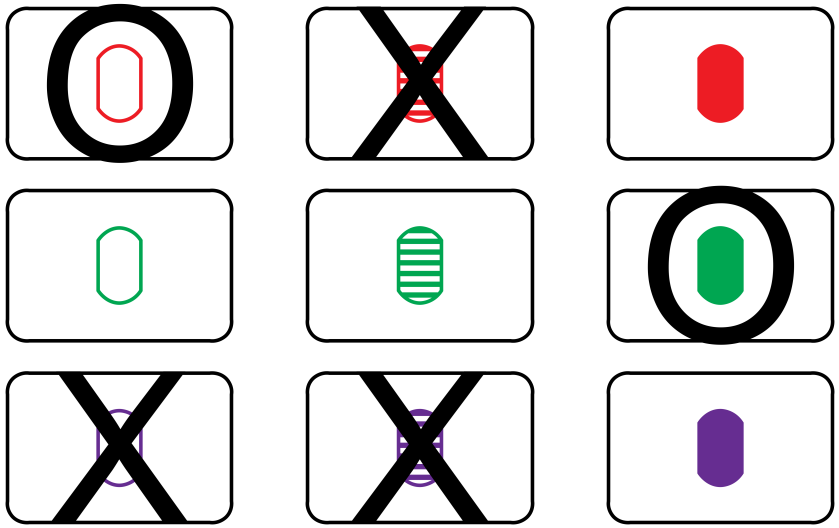
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

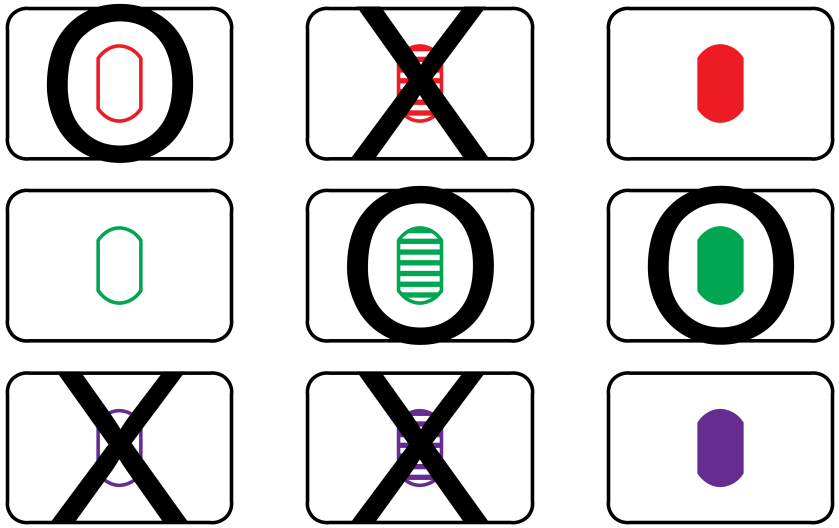
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

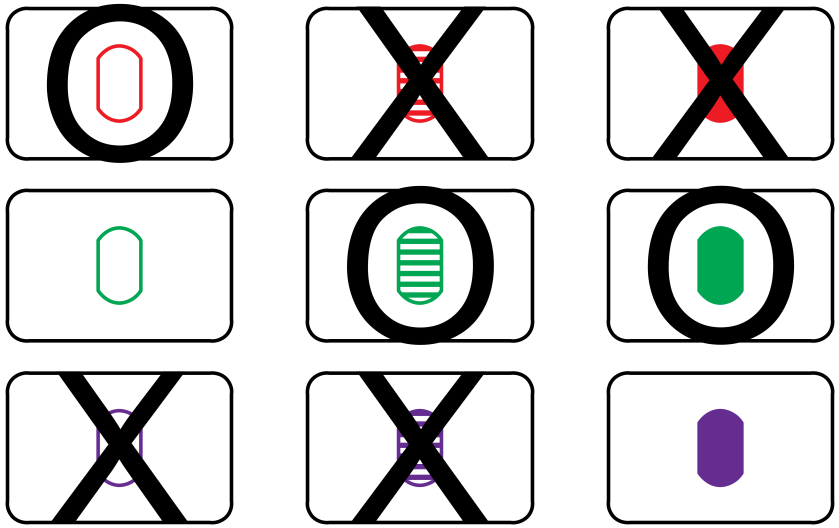
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

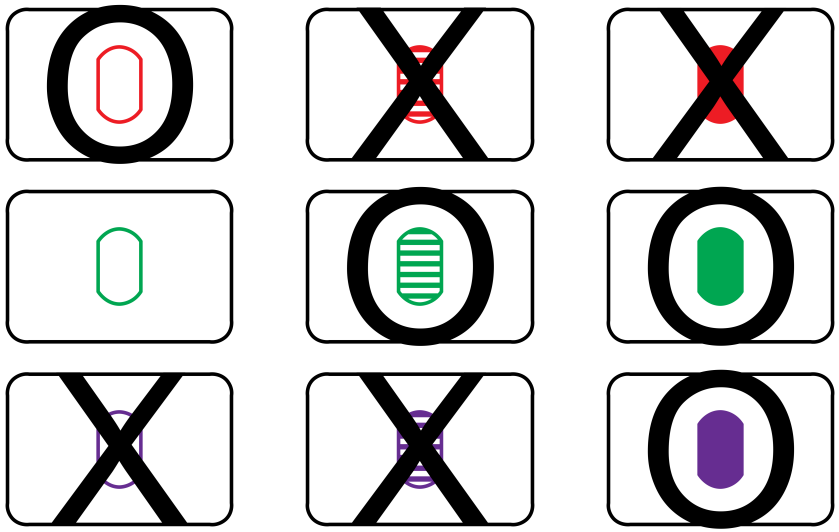
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

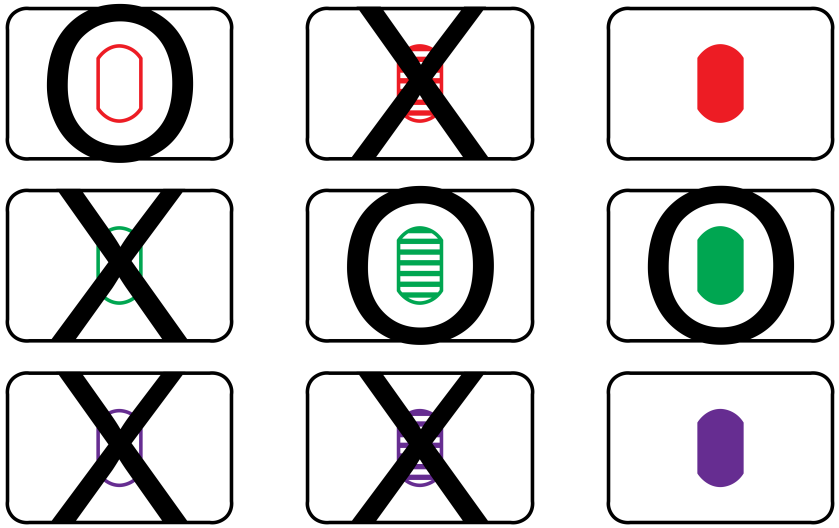
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

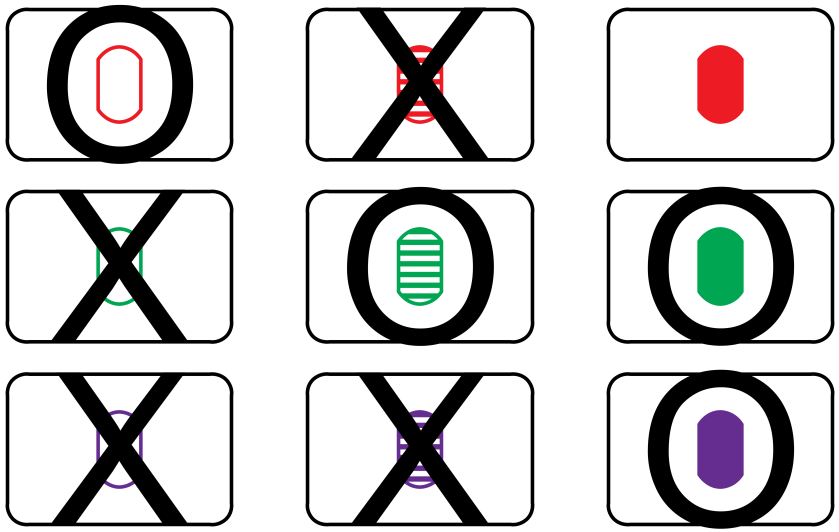
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

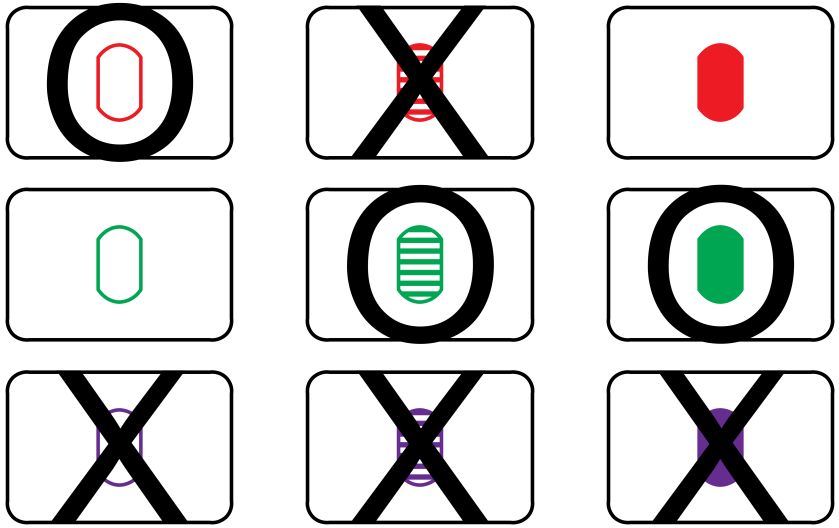
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



X wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

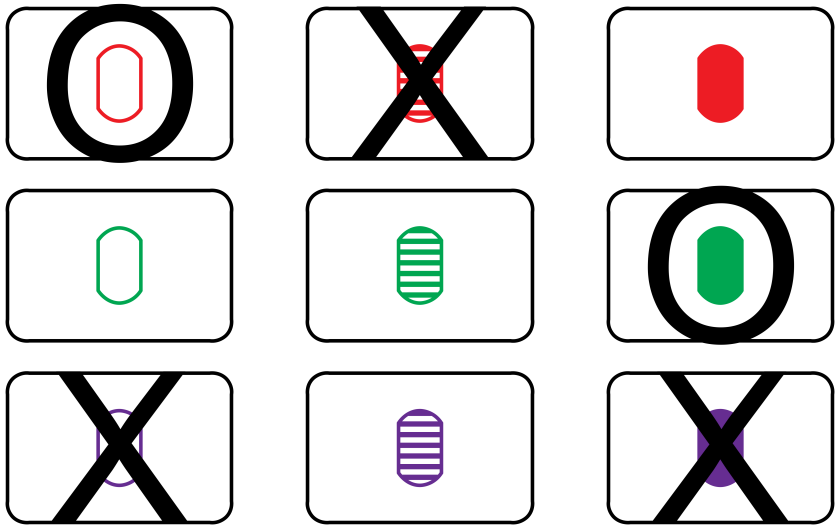
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

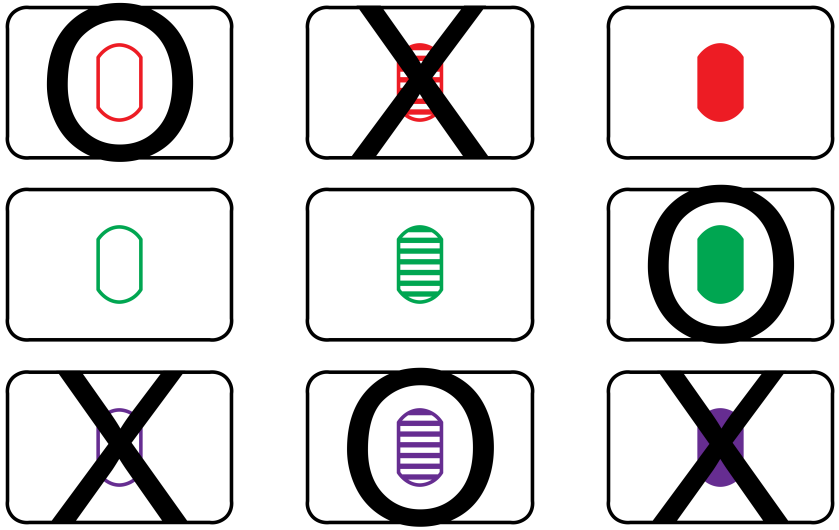
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

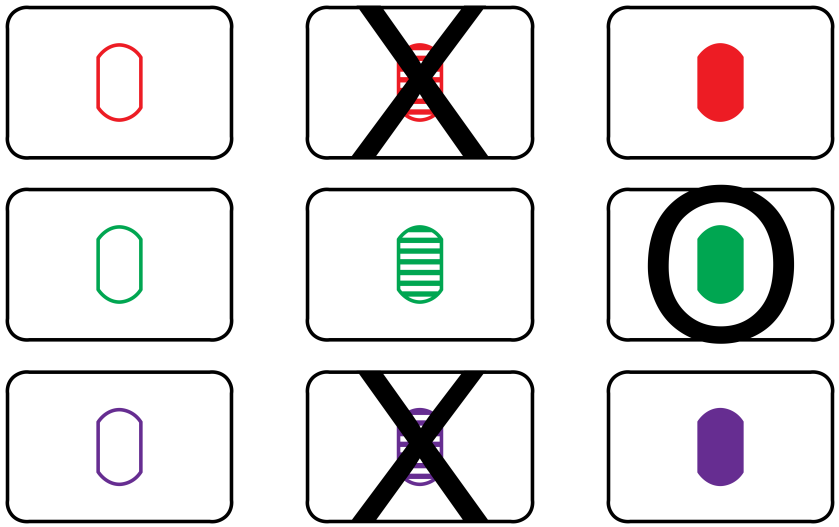
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

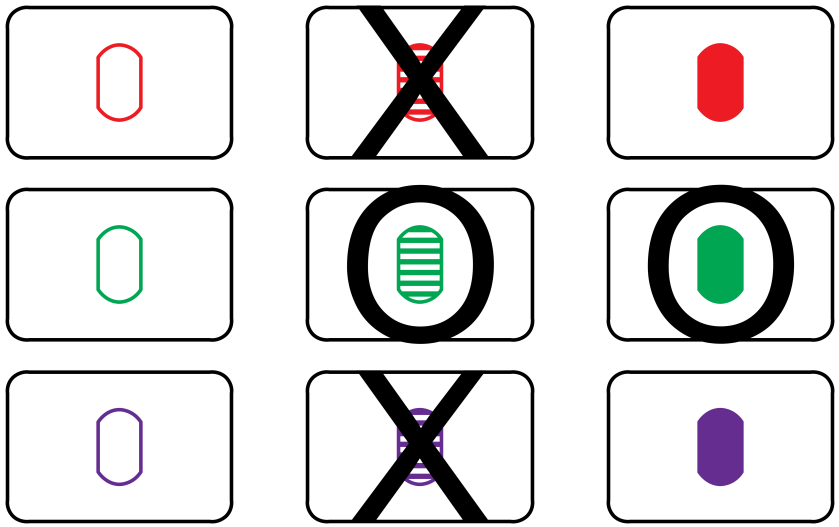
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

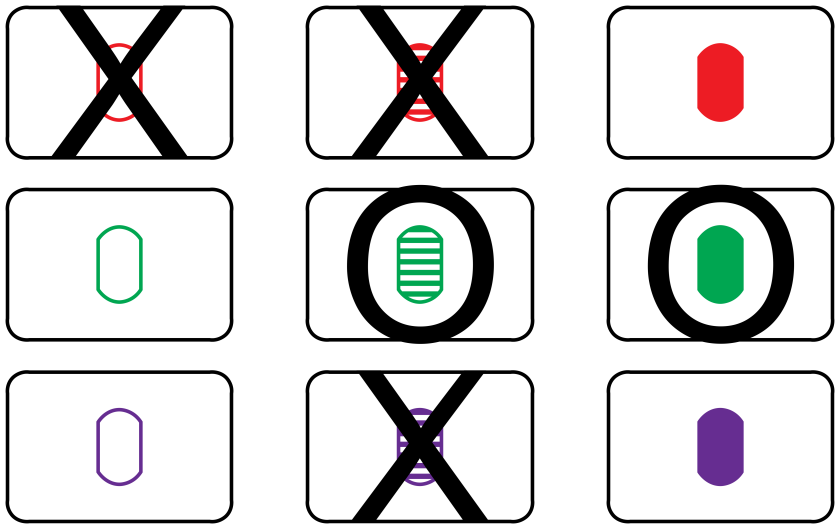
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

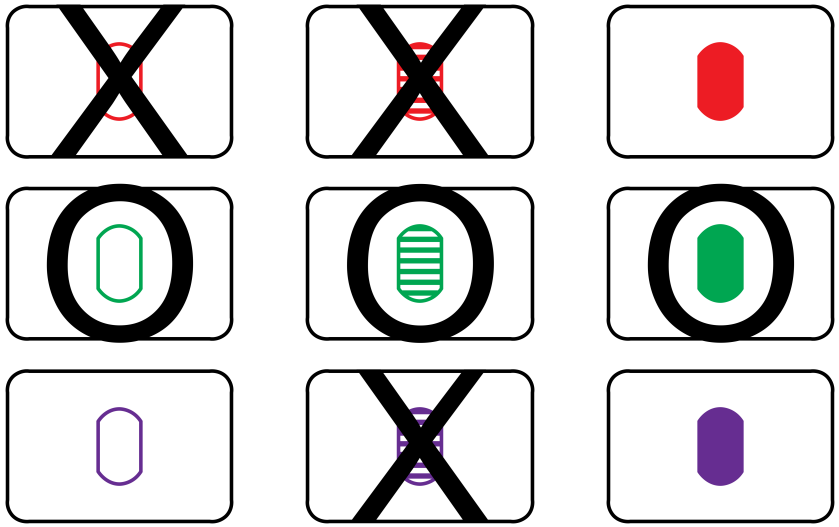
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

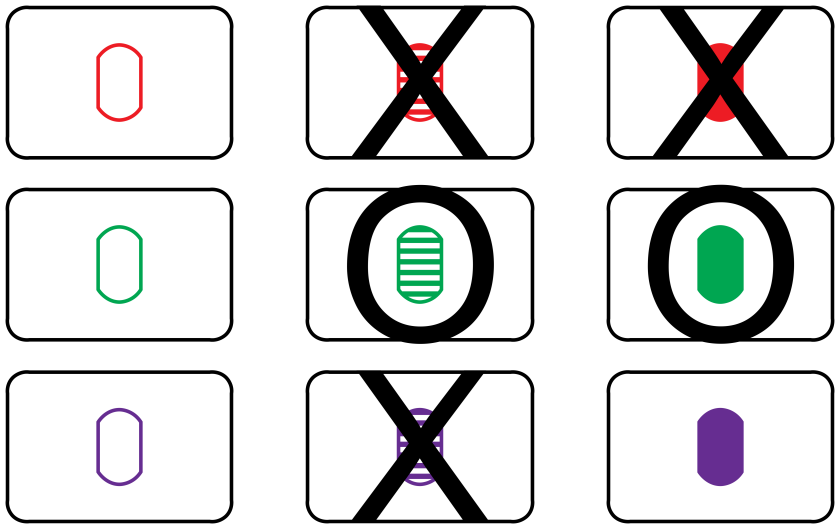
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

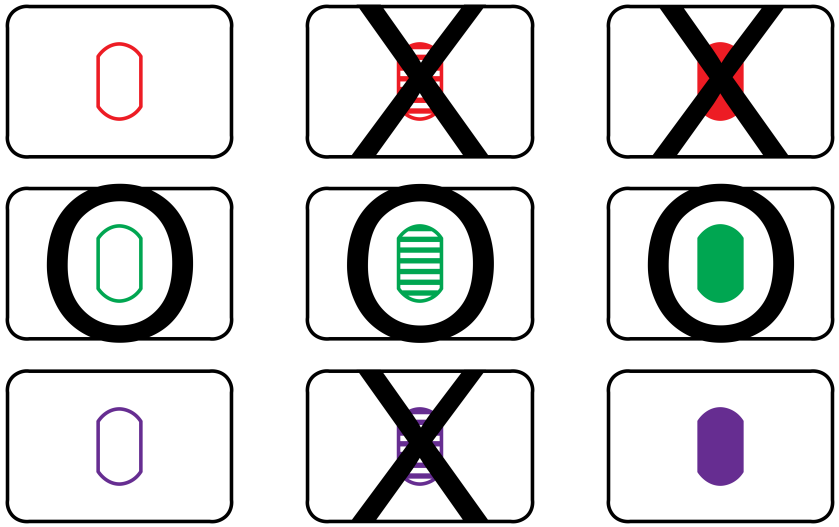
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

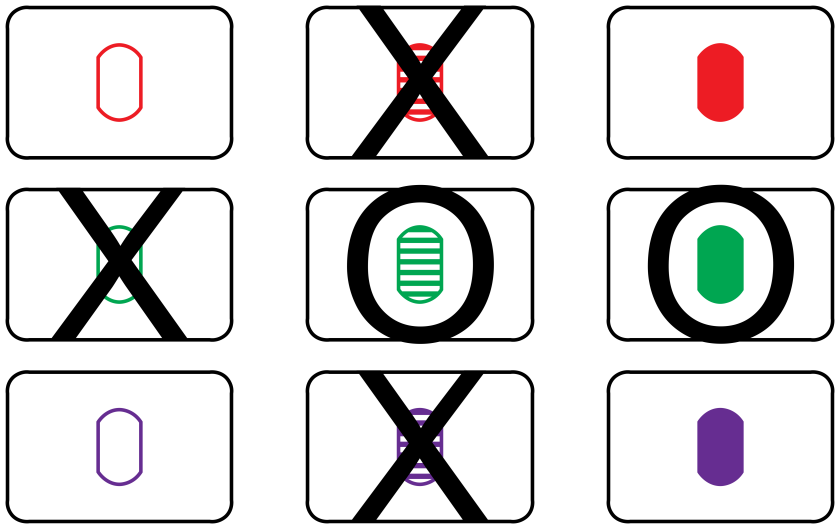
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

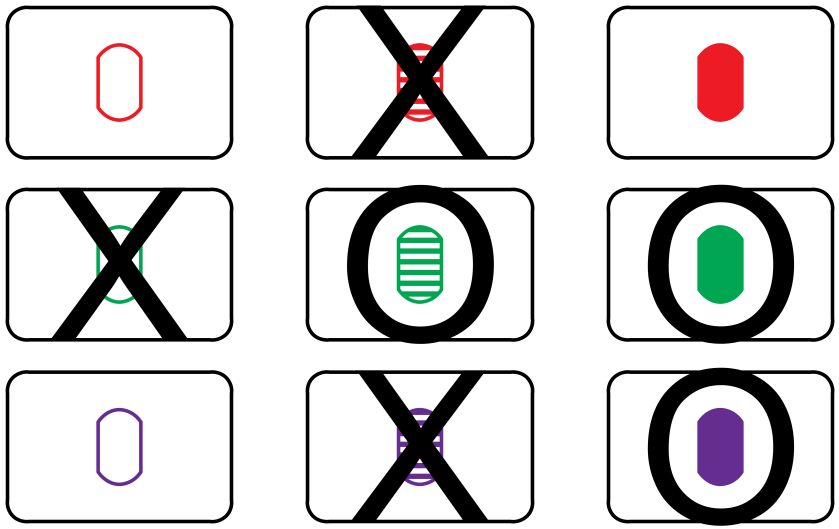
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

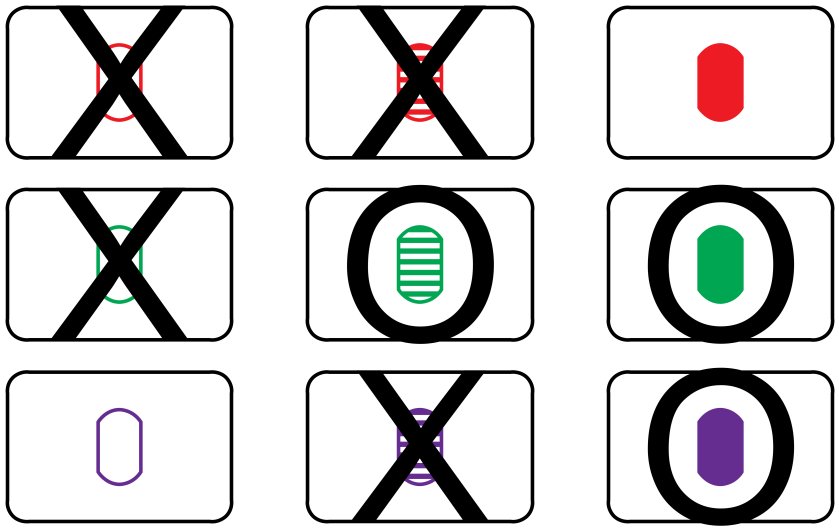
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

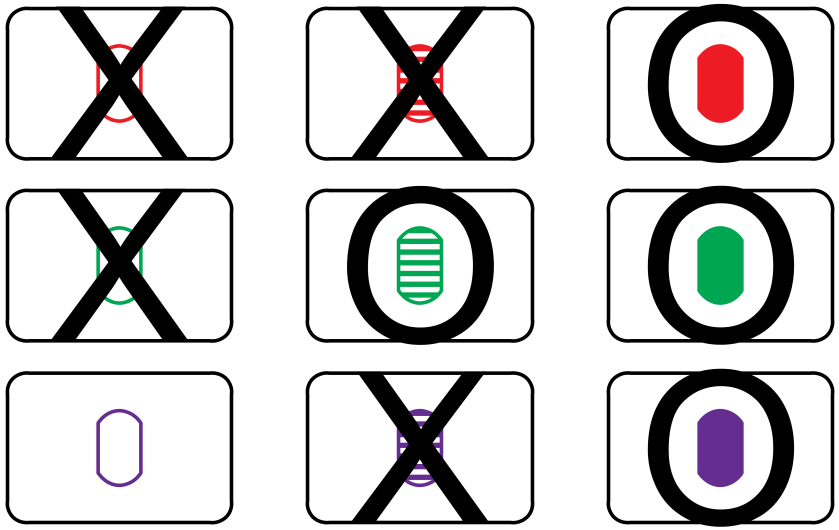
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

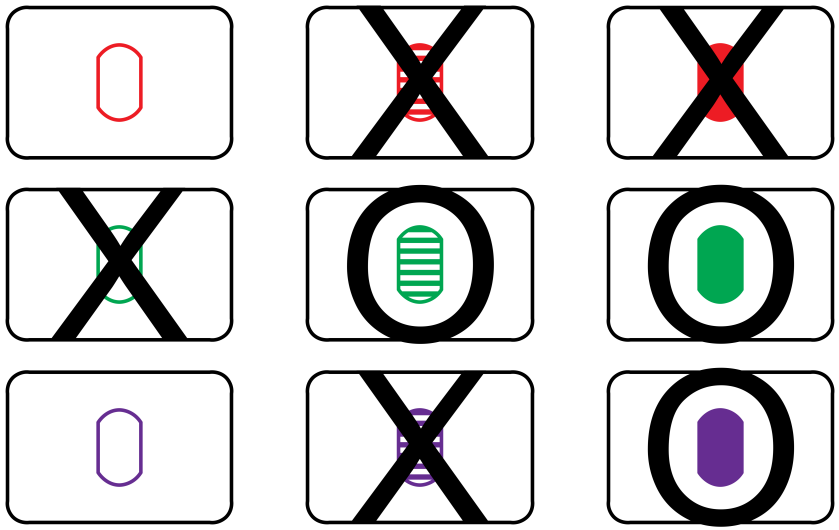
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



X wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

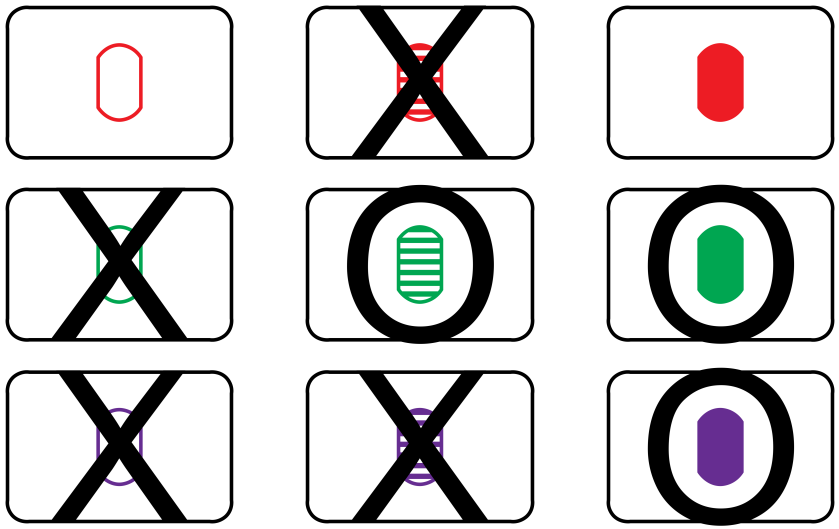
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

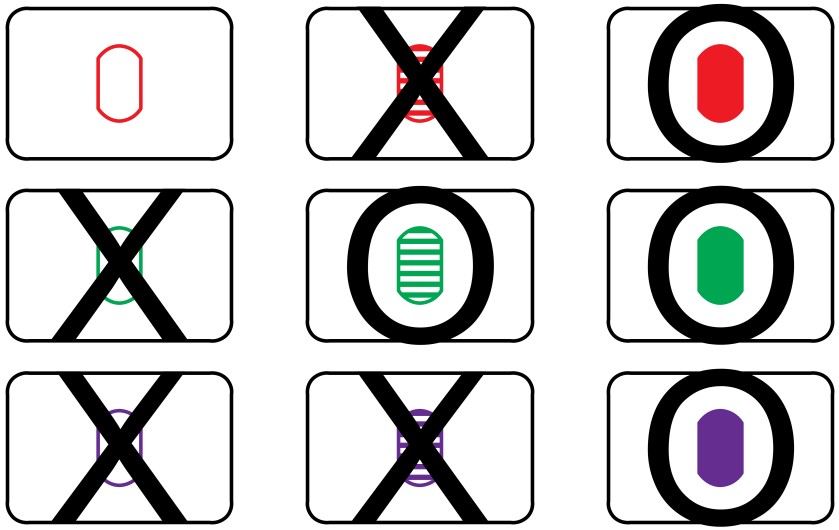
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

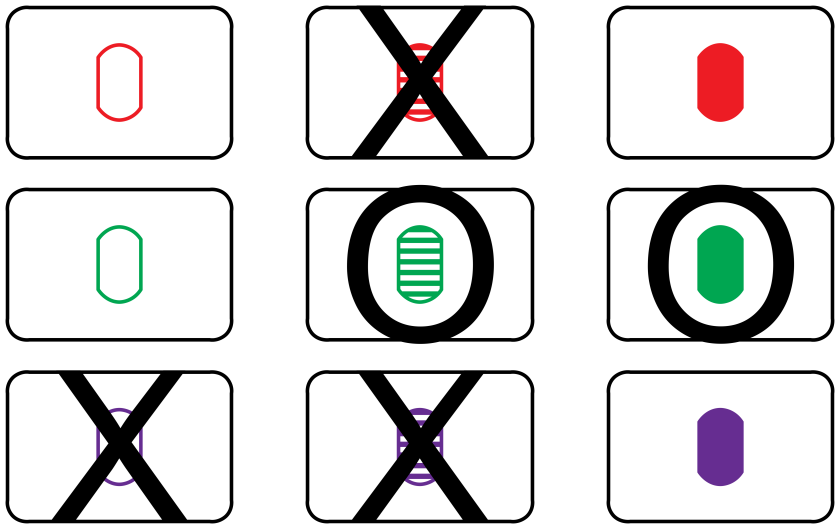
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

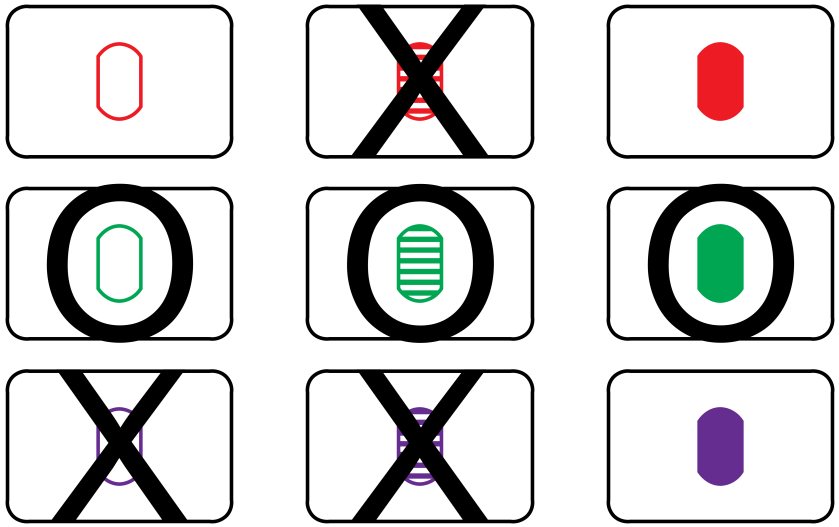
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

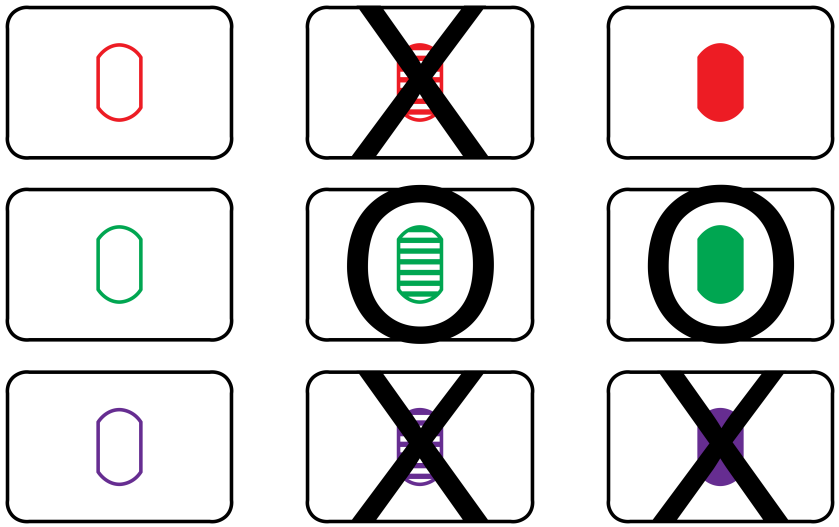
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

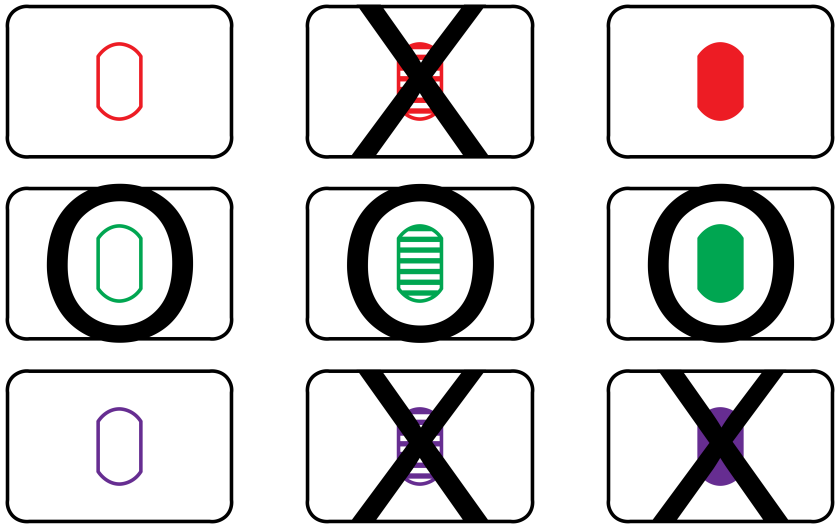
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

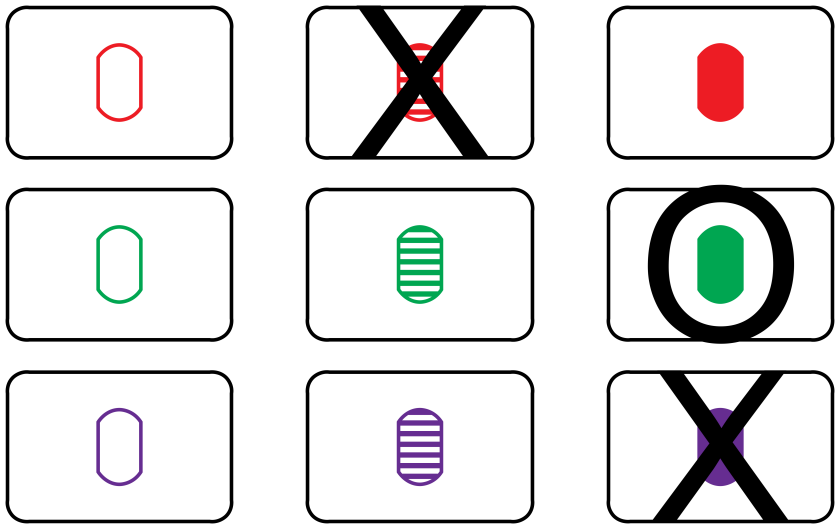
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

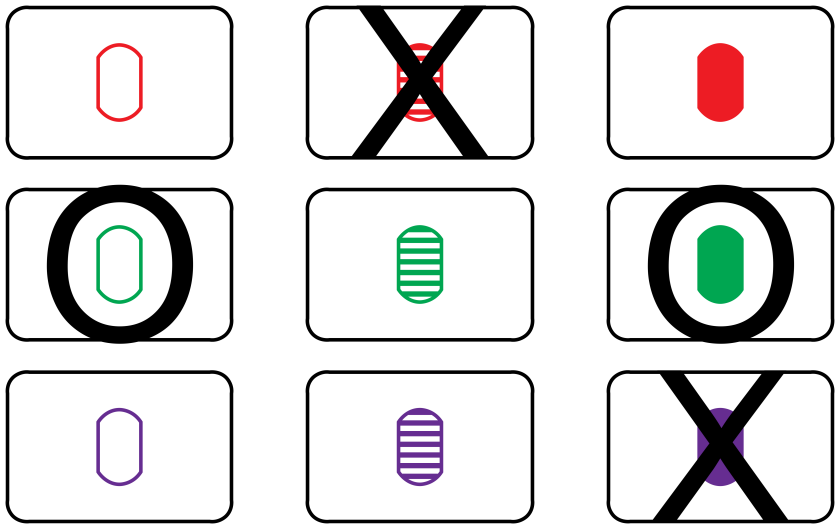
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

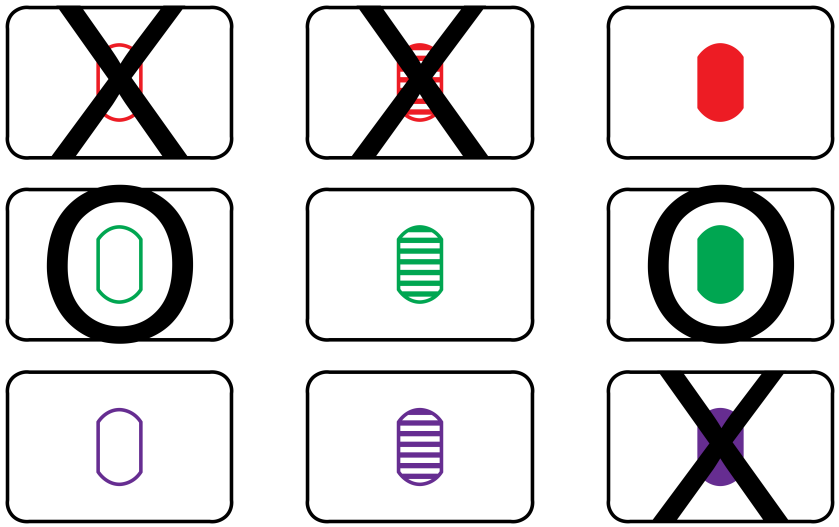
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

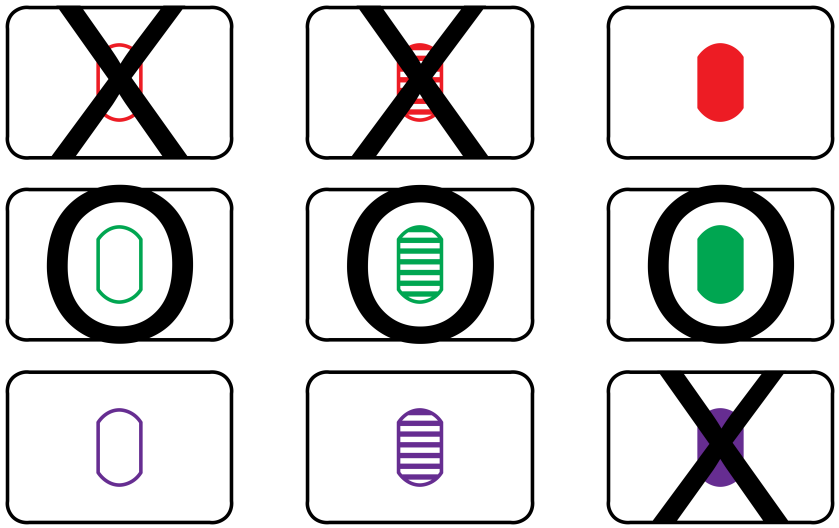
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

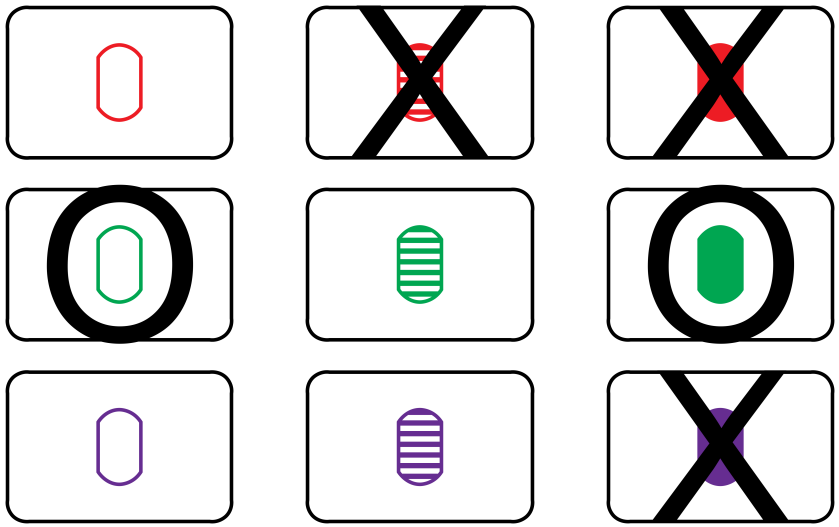
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

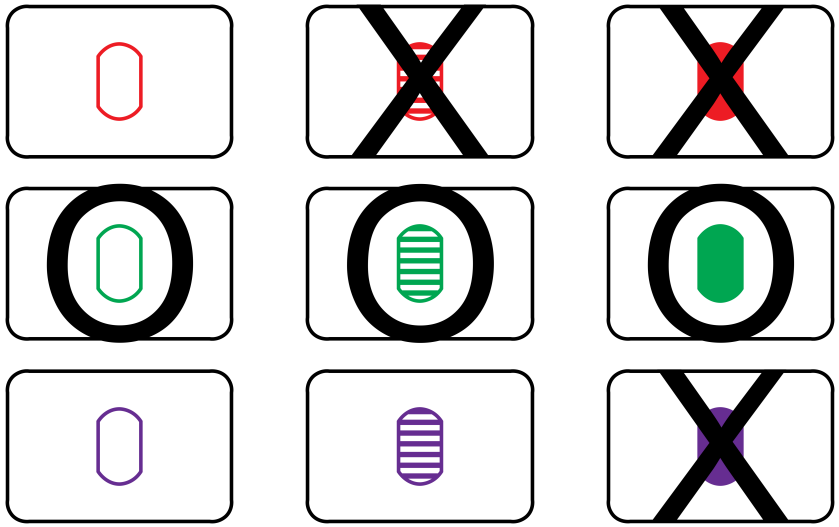
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

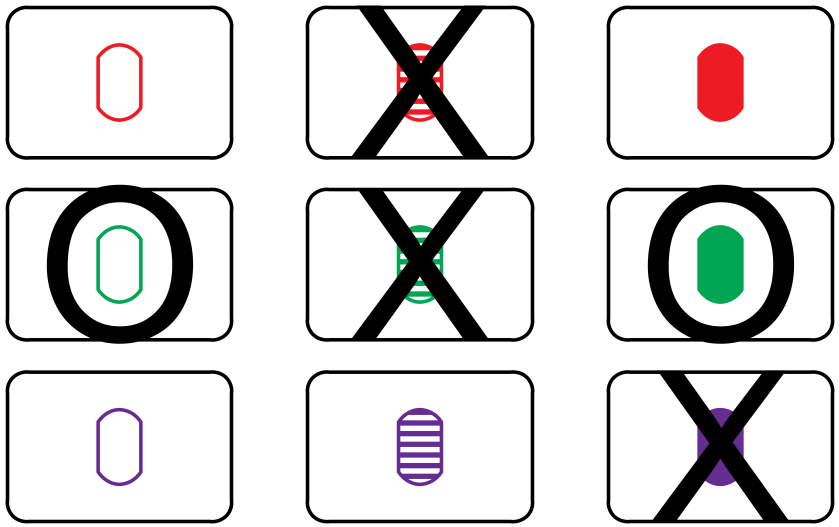
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

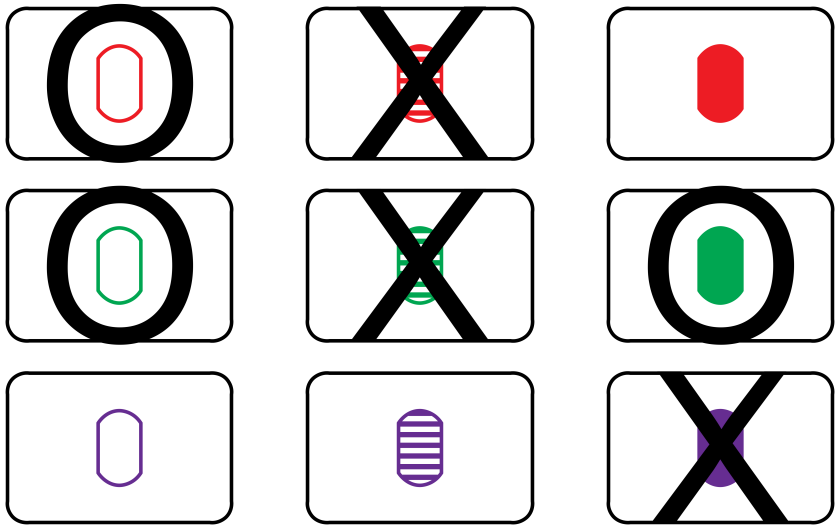
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

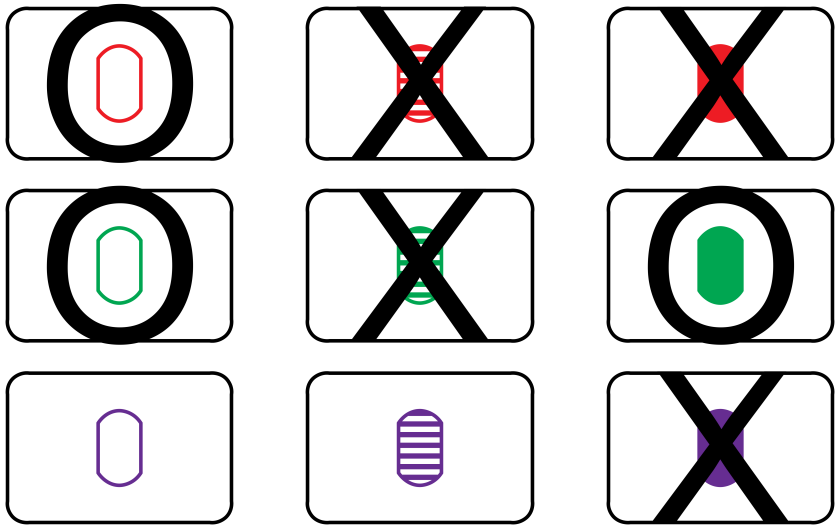
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

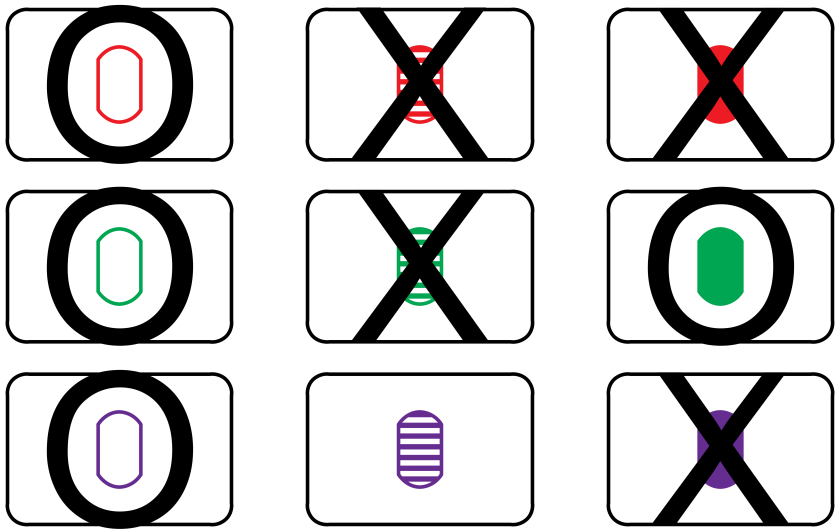
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

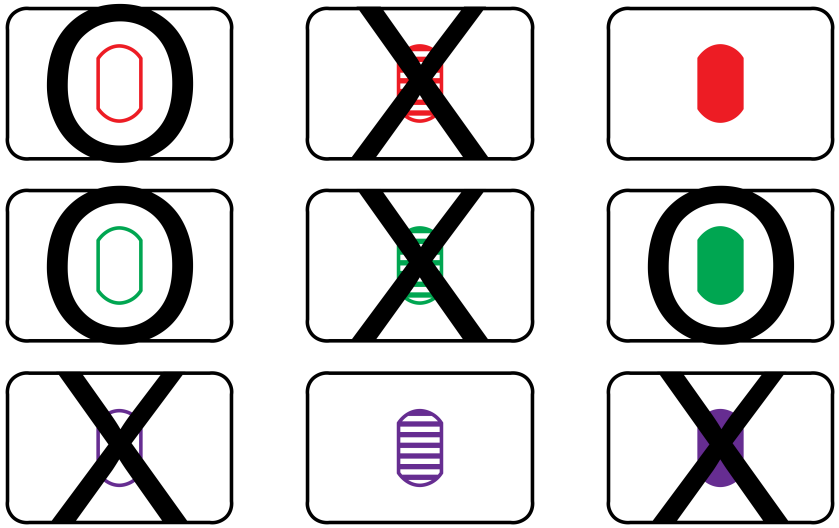
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

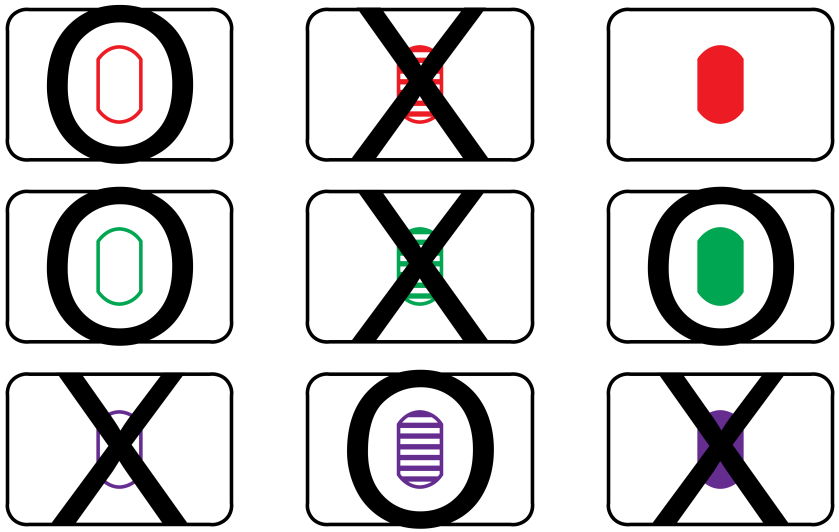
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

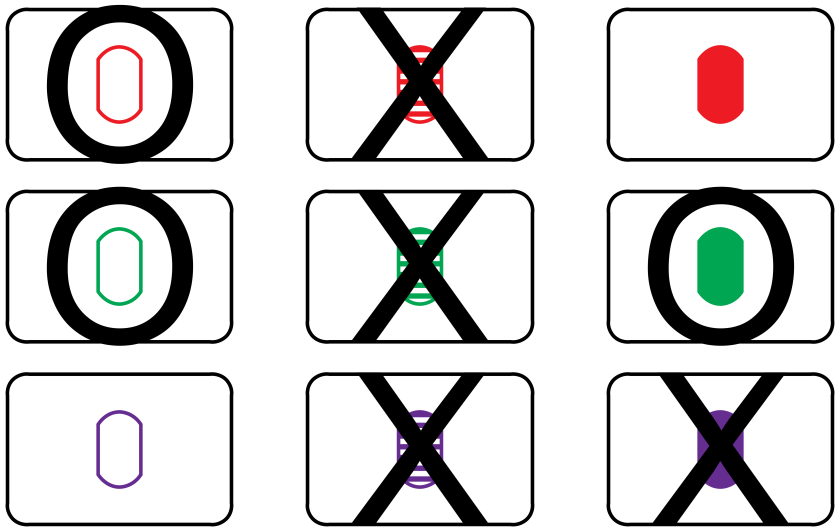
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



X wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

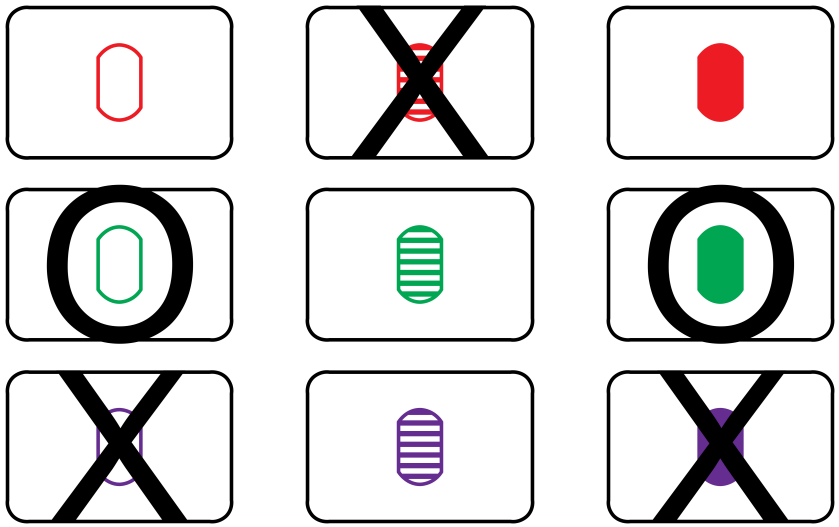
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

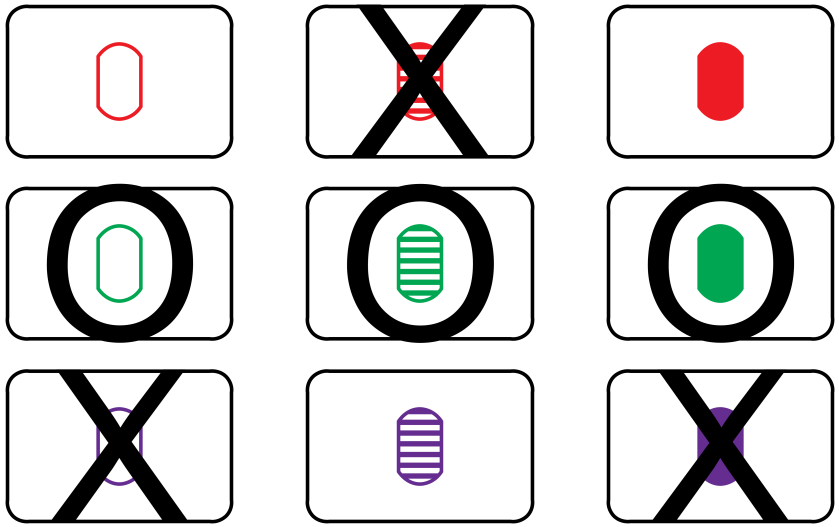
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

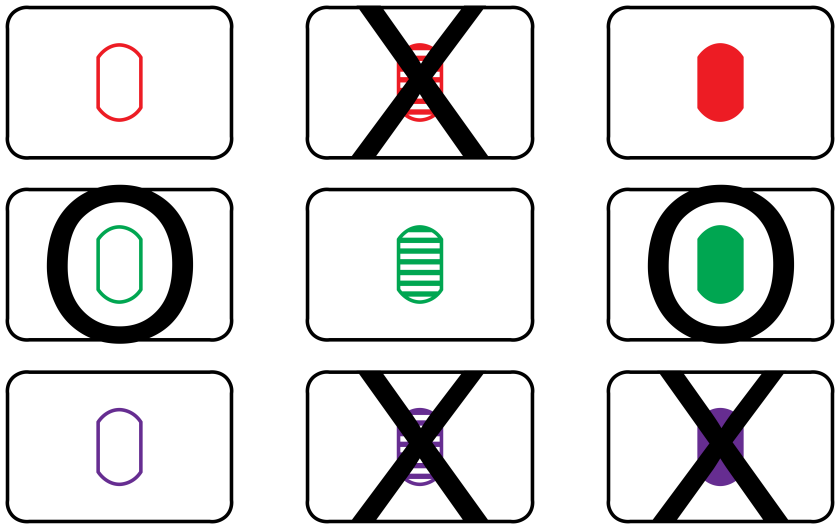
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



SET Tic-Tac-Toe Example

Hidden Dimension of SET: The Classification of Magic SET Squares

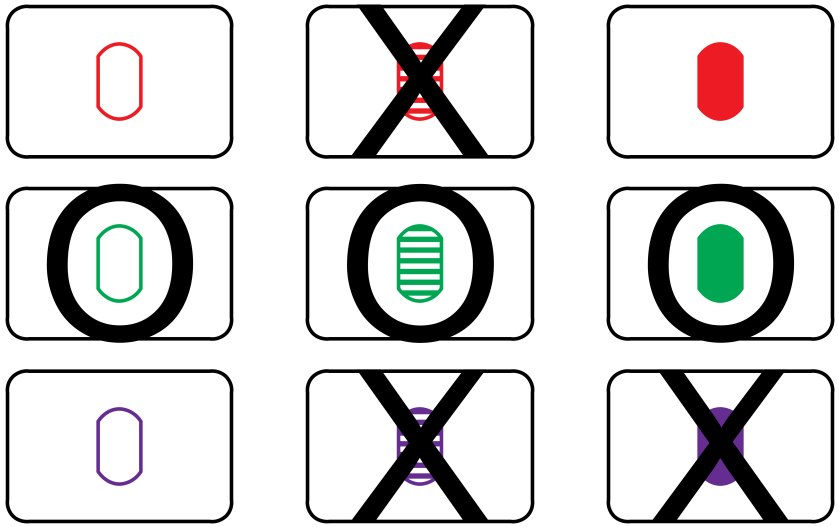
PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe



O wins!

Who wins?

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

- The first player will always win on their third or fourth turn if they play well.
- The game can never end in a tie.

Game of 15

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

- The game of fifteen consists of two players taking turns choosing cards from 1 - 9. The first to get 15 wins.

Game of 15

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

- The game of fifteen consists of two players taking turns choosing cards from 1 - 9. The first to get 15 wins.
- SET Tic-Tac-Toe is similar to the Game of 15, but not the same.

Game of 15

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

- The game of fifteen consists of two players taking turns choosing cards from 1 - 9. The first to get 15 wins.
- SET Tic-Tac-Toe is similar to the Game of 15, but not the same.
- Can you see why?

2	9	4
7	5	3
6	1	8

Acknowledgements

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Thank you

- PRIMES STEP, for providing this opportunity.
- Tanya Khovanova, for mentoring us.
- Our parents and families.

Acknowledgements

Hidden Dimension of SET: The Classification of Magic SET Squares

PRIMES STEP Junior Group, led by Tanya Khovanova

The Game of SET and Magic SET Squares

Classifying and Counting Magic SET Squares

Magic SET Squares and Group Theory

SET Tic-Tac-Toe

Thank you for coming!