Emory Math Circle

Shilpi Mandal

Which one do you think is the odd one out, and why?

Crab

Turtle

Butterfly

Snail

Tiger

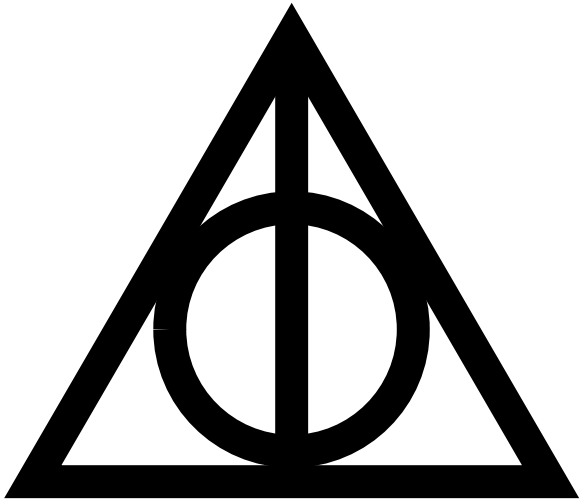
Warmup

- In your own words, what does it mean for something to have symmetry?

- Rotational symmetry
- Reflective symmetry

Examples

- Here are some objects. Describe their symmetries.
- An object can have **rotational symmetry,** or **reflective symmetry** (or **both**)



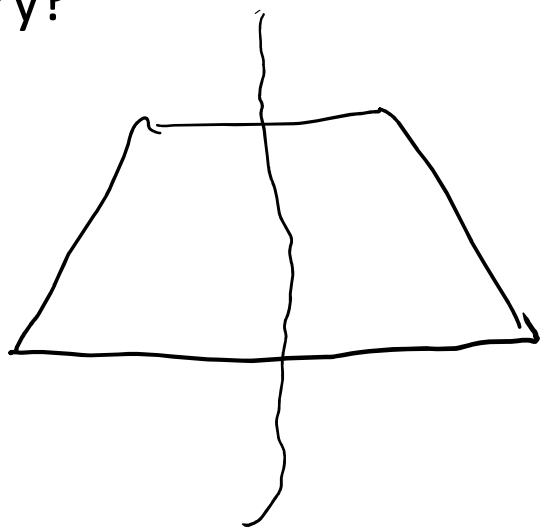
Your turn

- Can you draw a shape with rotational symmetry, but **not** reflective symmetry?

Think

Your turn

- How about a shape with reflective symmetry, but **not** rotational symmetry?



Your turn

- What would you say is the most symmetrical shape, and why?

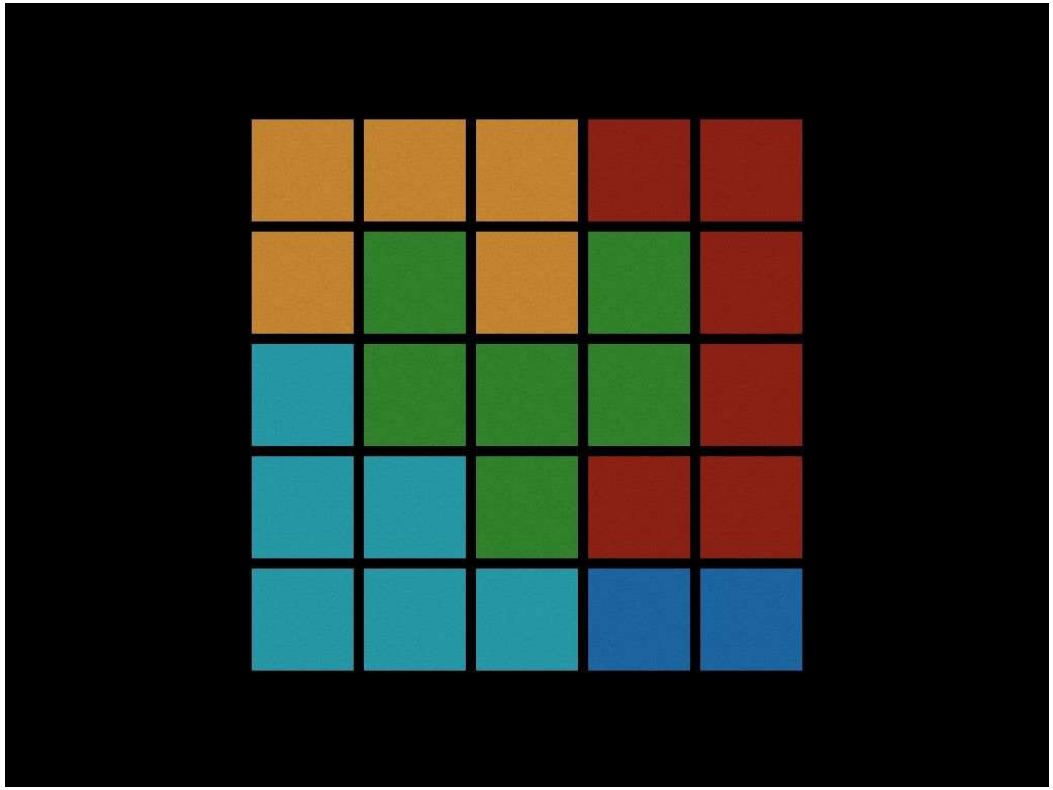
Breakout rooms

House of Mirrors

- A house of mirrors can be a dangerous place to live. Bump a wall and the whole house can fall around you – sharp shards everywhere. That’s why there are rules for anyone planning on building a house of mirrors.

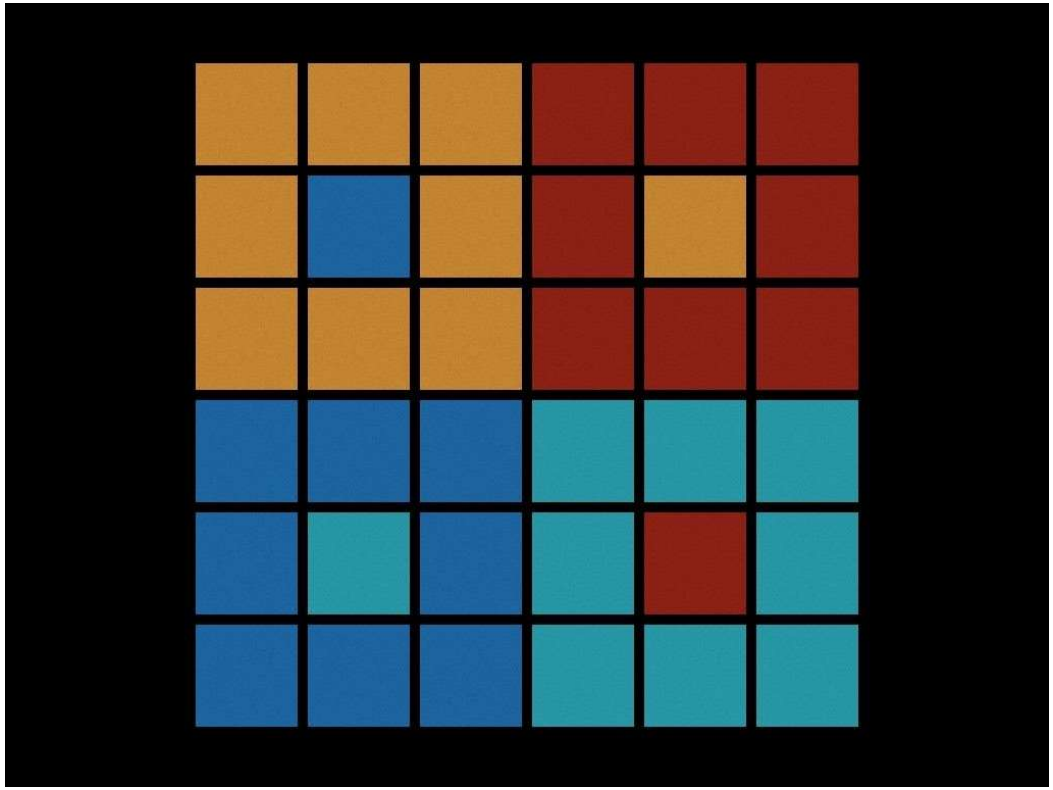
House of Mirrors: Rule 1

- EQUAL NUMBERS OF EACH COLOR.
- This house fails. Why?



House of Mirrors: Rule 2

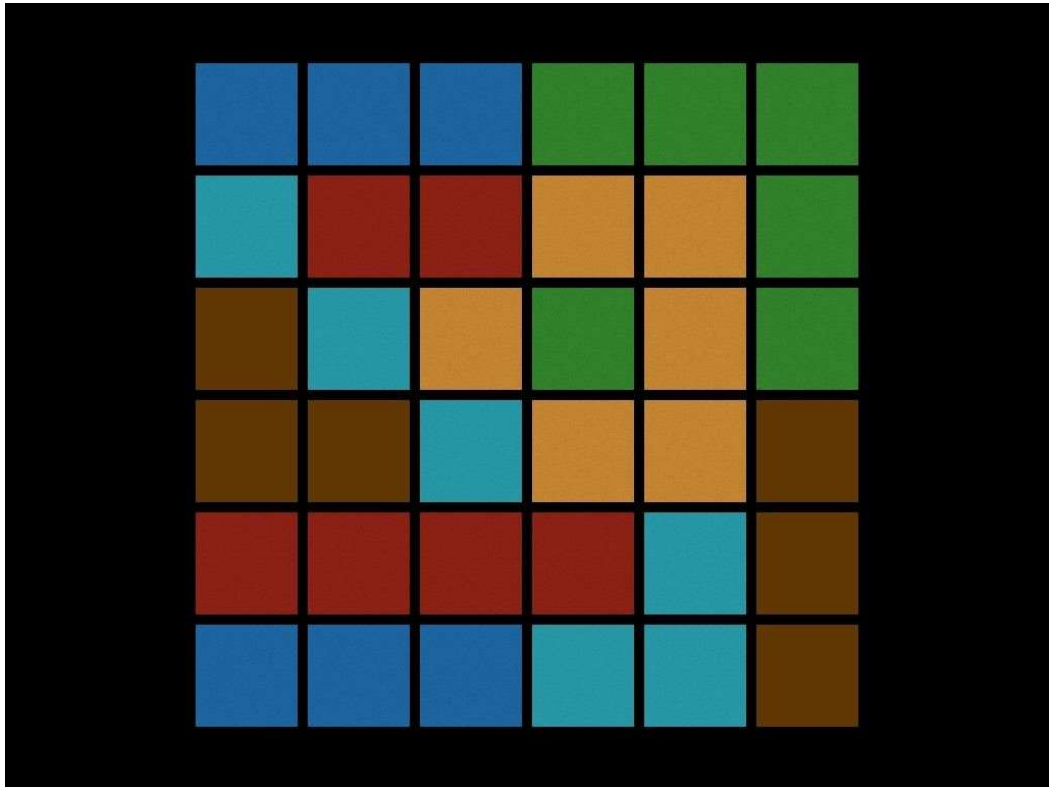
- All the colors must be DIFFERENT SHAPES.
- This house fails because …?



House of Mirrors: Rule 3

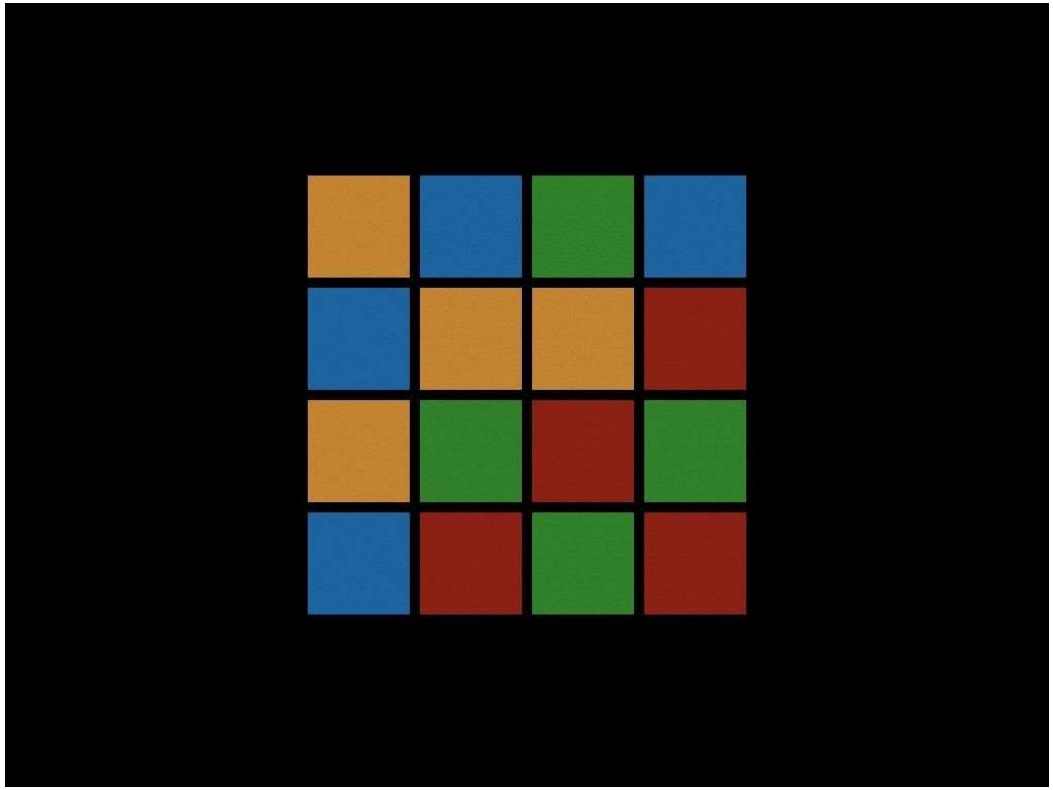
- All the colors must have MIRROR SYMMETRY (reflective symmetry).
- That's true even if the color is not connected.

- Are there any color(s) that do not have mirror symmetry?



House of Mirrors: Rule 4

- All the colors must have DIFFERENT LINES OF SYMMETRY.
- Can you see why this house of mirrors fails?

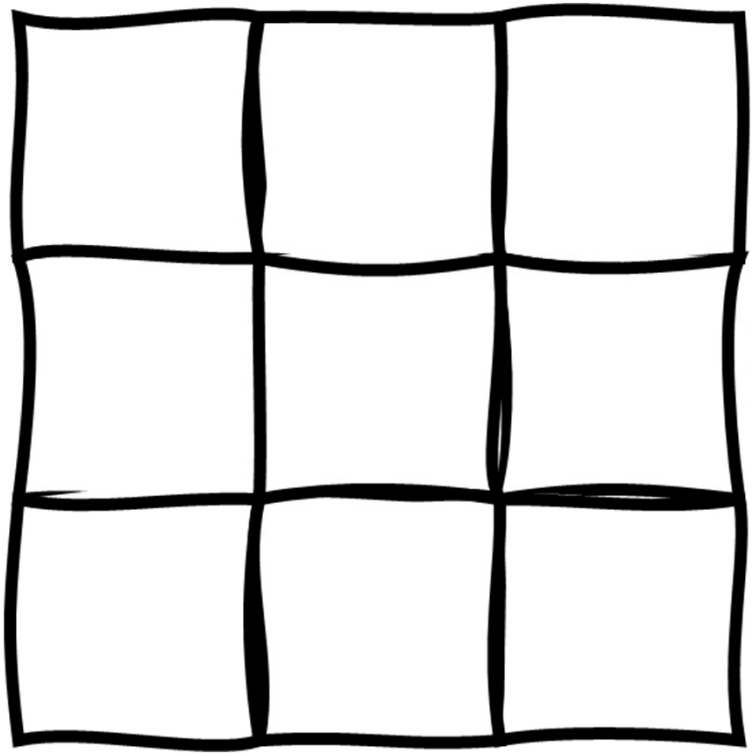


House of Mirrors: Summary

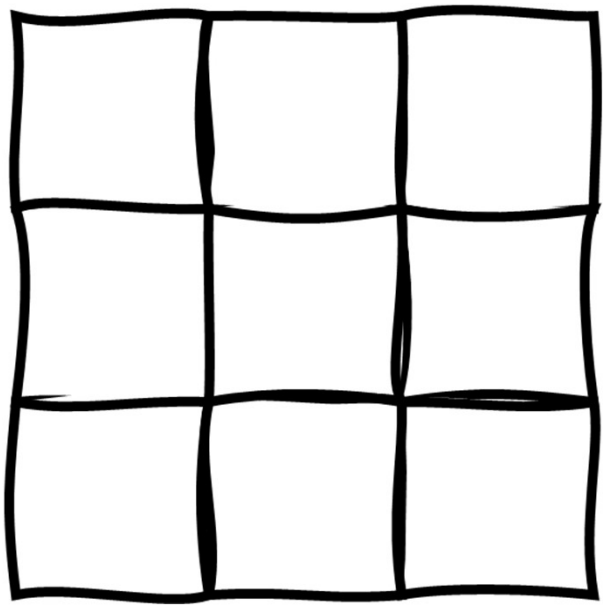
- EQUAL NUMBERS OF EACH COLOR
- DIFFERENT SHAPES
- MIRROR SYMMETRY
- DIFFERENT LINES OF SYMMETRY

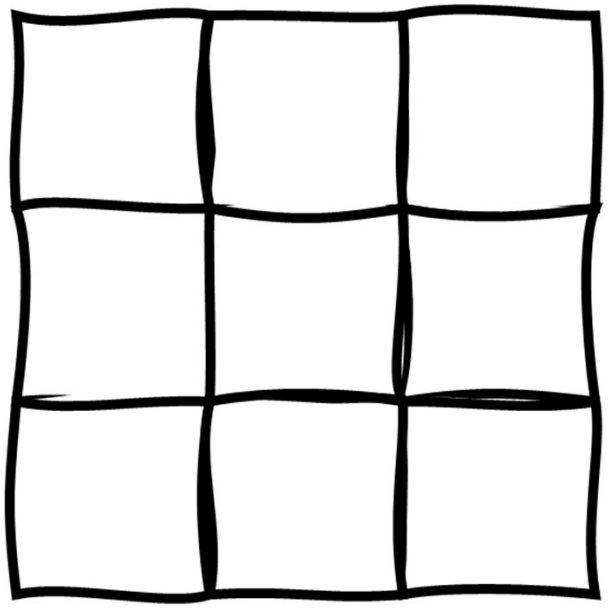
3x3 House of Mirrors

- Let’s try to build a 3×3 house of mirrors with 3 colors.



Can you find another 3x3 HoM?





House of Mirrors (symmetry, patterns, composite numbers) | MathPickle

What’s in a name?

- Shakespeare said this.

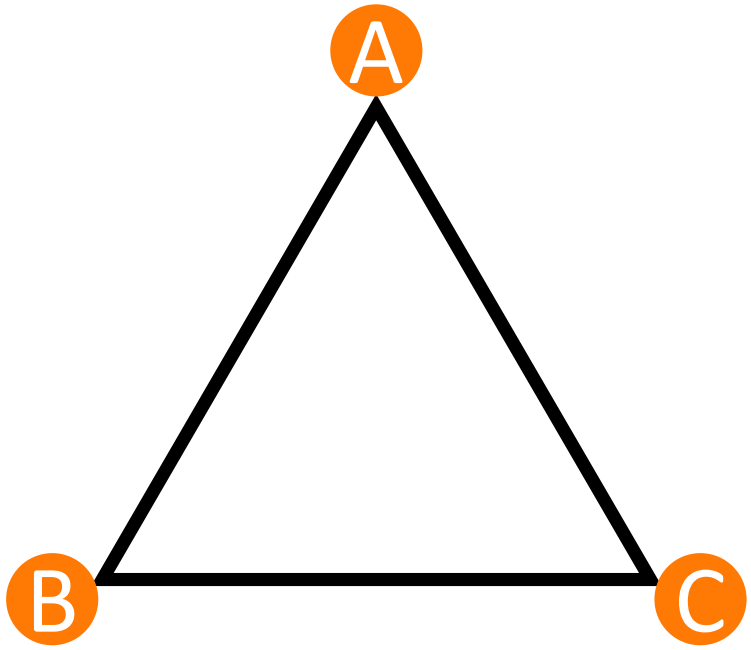
- So, let’s look at the name.

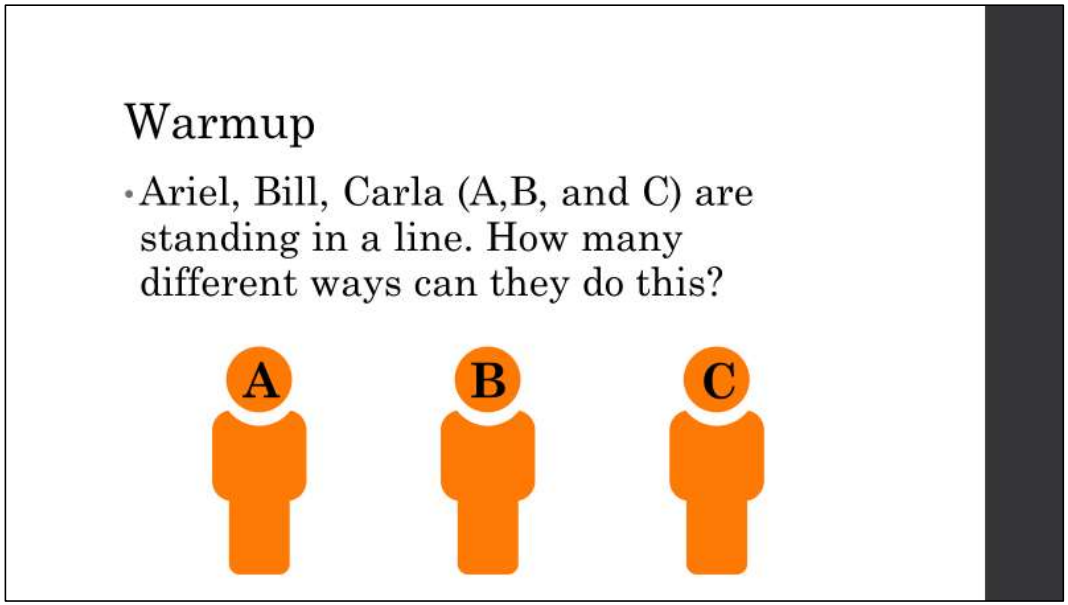
SHAKESPEARE

- For each letter in the name, does it have: reflective, rotational, vertical, horizontal symmetries?

Do you remember permutations?

- Instead of standing in a line, Ariel, Bill, and Carla are sitting at the corners of a triangle.



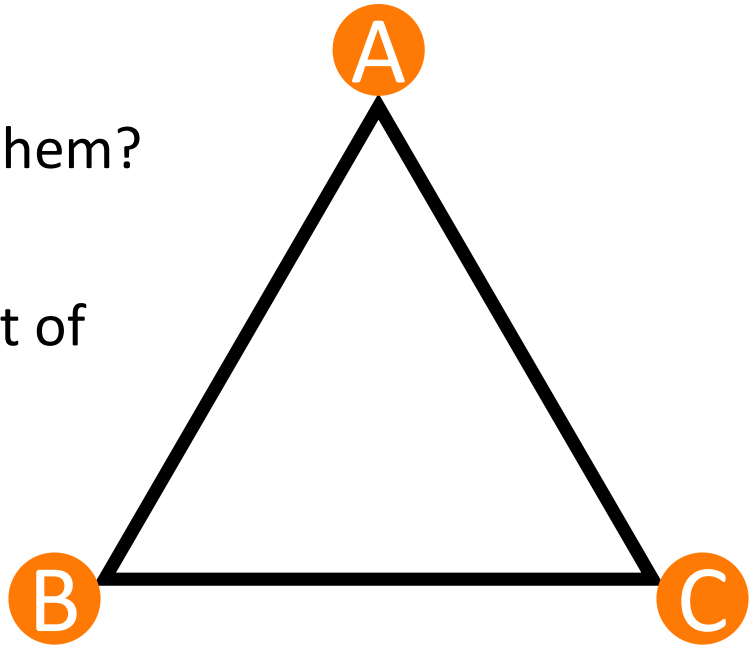


Do you remember permutations?

- Instead of standing in a line, Ariel, Bill, and Carla are sitting at the corners of a triangle.

- How many different ways can you seat them?

- Can you express these as rearrangement of numbers *1, 2, 3*?



Do you remember permutations?

- Instead of three people, we now have four people.
- Everyone moves one position to the right (so 1 moves to 2, 2 moves to 3, and so on).
- Can you draw this?

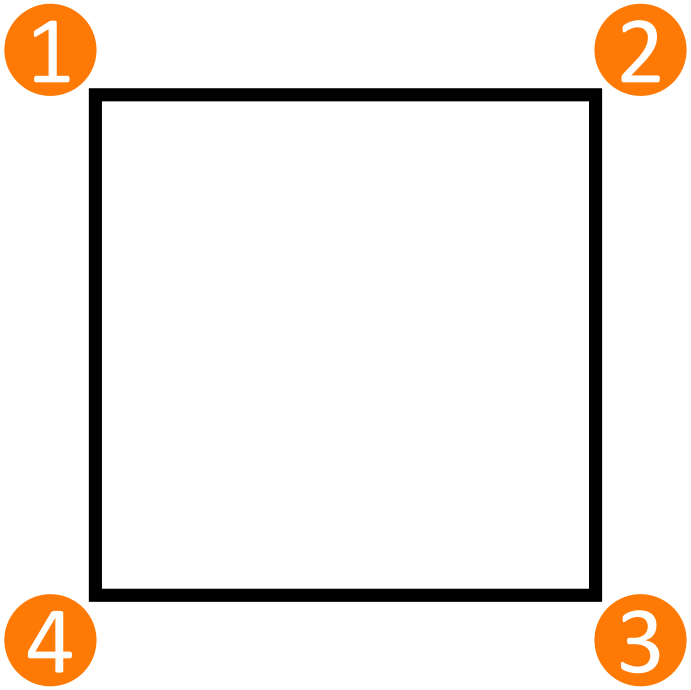
Permutations and Symmetry

- Can you think of the following permutations in terms of symmetries?

- 1,2,3,4 → 1,4,3,2

- 1,2,3,4 → 4,3,2,1

- 1,2,3,4 → 2,1,4,3



Think about it!!

- Can you see a relation between permutation of numbers $1, \ldots, n$ with the symmetries of a polygon of n sides?

THANK YOU!!!