

GERRYMANDERING

FESTIVAL GUIDE

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Mathematics
Festival**

Materials and Setup

Per table (assuming 5 students per table), you will need:

Per Table		Material Preparation
3 copies of Instructions	1-page sheet	p. 7
5 copies of Tasks	4-page sheet in dry erase sleeves <i>can be printed double-sided</i>	p. 8-11
1 copy of Table Sign	1-page sheet <i>print on cardstock for sturdiness</i>	p. 12
10 dry erase plastic sleeves		
5 dry erase markers		
5 dry erase marker erasers		

Per Table		Purchasing Materials	
dry erase combo	30 piece set for \$22.53		Set comes with 30 plastic sleeves, 30 markers, and 4 erasers.
3 plastic sheet protectors	pack of 100 for \$7.67	pack of 500 for \$26.99	These are recommended in order to protect the instructions.



Objective

On a grid of blue and purple squares, outline three groups of which two must be more than half purple.

Rules:

1. On a 3 x 3 grid, make 3 groups with 3 squares in each group.
2. In each group, all of the squares need to be connected (corners don't count).

Materials

Each Gerrymandering table should be prepped for 5 stations.

Each station needs:

1. Gerrymandering instructions.
2. Gerrymandering tasks in dry erase sleeves.
3. 1 dry erase marker and eraser.

How to Play

We strongly encourage you to explore the activity yourself ahead of time.

You can try our digital version here: jrmf.org/puzzle/gerrymandering

Introduce the activity without overexplaining it and without telling what strategies students might want to use. As much as possible, avoid giving away answers. Students should be encouraged to explore, experiment, and learn from their mistakes.

1. Use the first puzzle to explain the rules. Circle three squares and ask which color covers more than half the squares. Tell the student that means that color 'wins' that group. Repeat two more times.
2. Then ask the student which color won the most groups. For example, if blue won the first group, then purple won the next group, and blue won the third group, then blue won 2 times and purple won once. That means blue is the final winner.
3. Ask the student if they can redraw the groups so that purple is the final winner.

Standards

1. Make sense of problems and persevere in solving them. CCSS.MP1
2. Construct viable arguments and critique the reasoning of others. CCSS.MP3
3. Model with mathematics. CCSS.MP4
4. Look for and make use of structure. CCSS.MP7



Asking Good Questions

1. Ask questions about confidence.
 - a. When a student asks you “Is this right?”, instead of saying “yes” or “no” right away, ask them how confident they are in their answer. Here are some examples:
 - i. “Maybe. What do you think? How confident are you?”
 - ii. “On a scale of 1-5, how confident are you in your answer?”
 - b. If a student is not confident in their answer, follow up by asking “What would help you feel more confident in your answer?” or “Why do you not feel confident?” This helps you determine how best to help the student through their explorations.
2. Ask students about choices.
 - a. When a student is stuck or shows you a wrong answer, instead of jumping in and showing the student the correct answer, start by asking about the choices that the student made along the way. Here are some suggested steps to follow:
 - i. Start from the beginning.
 - ii. Ask students to show you what they’ve tried so far.
 - iii. When the student gets to a point where they have different choices, ask the student “What other choices can you make here?”
 - iv. Have the student make a different choice and try to solve the puzzle. This helps the student see that they have the power to make different choices during an activity, and they’ll start to do this on their own in the future.
 - v. If you’re familiar with the puzzle or a particular solution, stop the student only when a different choice will help them get to the solution. This will help them feel successful faster without you giving away too much of the answer.
3. Ask students about strategies.
 - a. If a student is getting into the activity and has been doing it for a while, ask the student if there are any strategies they’ve come up with to help them solve the puzzle or win the game.
 - b. Follow up by asking if they think their strategies will work for all puzzles and/or larger puzzles, more complex puzzles, etc. Have the student explore more complex puzzles to test out their strategies.
 - c. This is a great way to encourage a student to dive deeper into an activity and to start looking for patterns, structure, and proofs.
4. Activity specific questions.
 - a. What is the minimum number of purple squares needed for purple to win?
 - If there are more than that, can purple still lose?
 - b. To win with a minimal number of purple squares, what must be true about all losing regions?
 - c. What number of purple squares guarantees that purple will win, no matter how the groups are made?
 - d. Which squares should we try to put into groups first?
 - e. Can you try looking at it from blue’s point of view instead of purple?

Answers

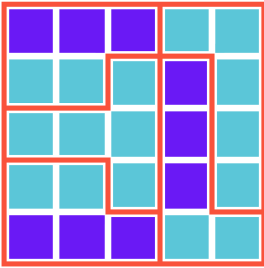
Below are example solutions. Some puzzles may have more than one solution.

There are three main reasons why a puzzle may be impossible:

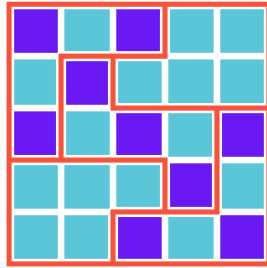
1. **There aren't enough purple squares.** For example, in Puzzle 3, there are only 3 purple squares, but there must be at least 4 to make 2 purple groups.
2. **The purple squares are too far apart.** For example, in Puzzle 6, there are 4 purple squares, just enough to make 2 purple groups. However, the purple square in the bottom right corner is too far away from the other purple squares to be a part of a purple group. That leaves only 3 purple squares that can be part of a purple group, which isn't enough to make 2 purple groups.
3. **You can't make enough entirely blue groups.** For example, in Puzzle 9, there are 4 purple squares, just enough to make 2 purple groups. Because there are three groups in total, one of the groups must only have blue squares. However, each blue square is entirely surrounded by purple squares; there is no way to make a group that only has blue squares.

Puzzle 1 	Puzzle 2 	Puzzle 3 Impossible	Puzzle 4 	Puzzle 5 	Puzzle 6 Impossible
Puzzle 7 	Puzzle 8 	Puzzle 9 Impossible	Puzzle 10 	Puzzle 11 	Puzzle 12 Impossible
Puzzle 13 	Puzzle 14 	Puzzle 15 Impossible	Puzzle 16 	Puzzle 17 Impossible	Puzzle 18

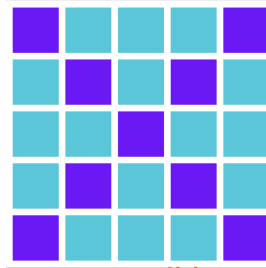
Puzzle 19



Puzzle 20

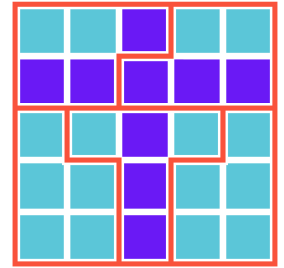


Puzzle 21

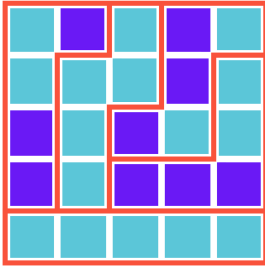


Impossible

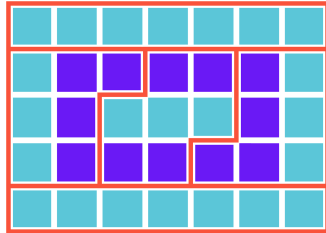
Puzzle 22



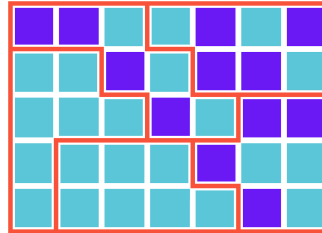
Puzzle 27



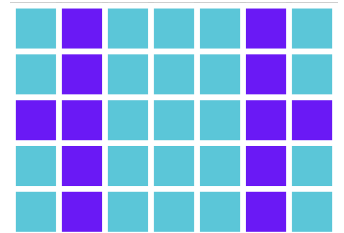
Puzzle 28



Puzzle 29

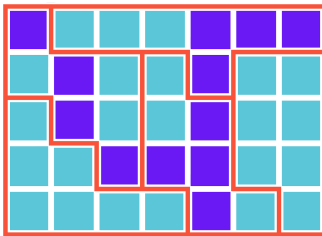


Puzzle 30

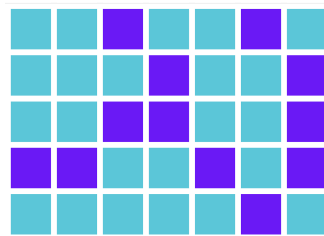


Impossible

Puzzle 31

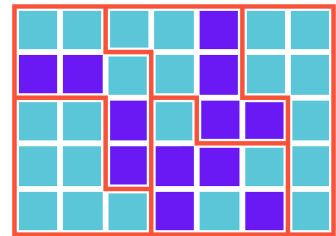


Puzzle 32



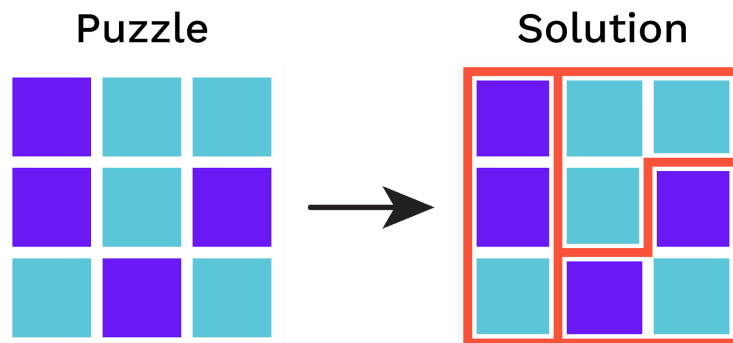
Impossible

Puzzle 33



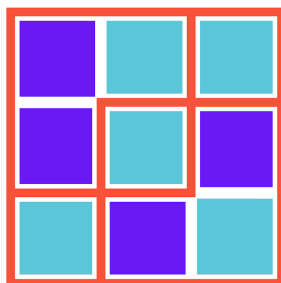
Gerrymandering Instructions

Make 3 groups so that 2 are purple groups.

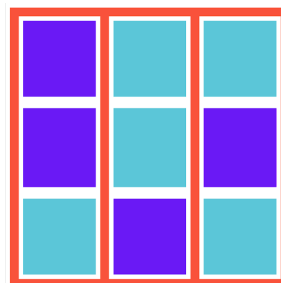


Rules:

3. Make 3 groups with 3 squares in each group.
4. In each group, all of the squares need to be connected (corners don't count).
5. In each puzzle, 2 of the groups need to be purple groups. In a purple group, more than half of its squares are purple.



Only 2 of the groups
have connected squares.

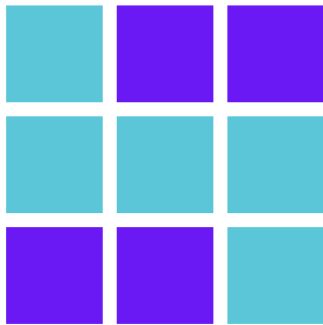


Only 1 of the groups
is a purple group.

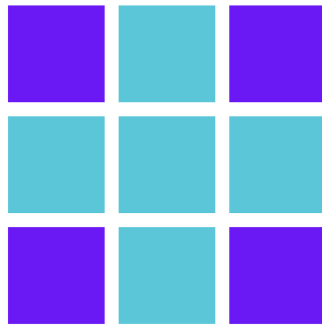
Gerrymandering Tasks

- Make 3 groups with 3 squares in each group.
- In each puzzle, 2 of the groups need to be purple groups.
- At least two of the puzzles below are impossible. Which puzzles are impossible, and why are they impossible?

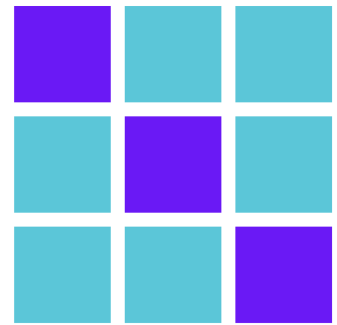
Puzzle 1



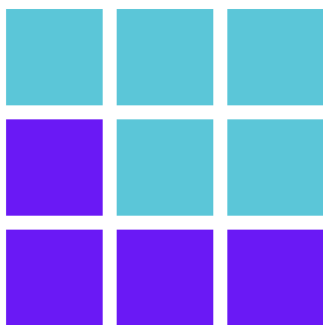
Puzzle 2



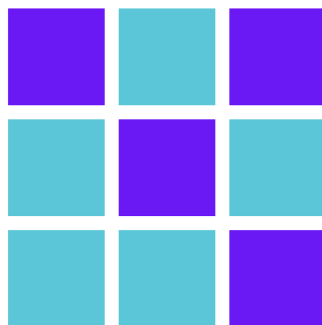
Puzzle 3



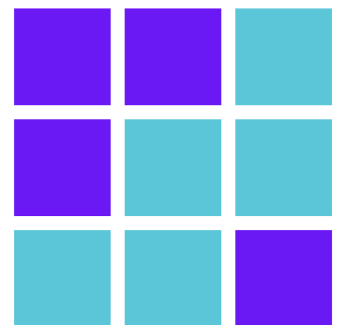
Puzzle 4



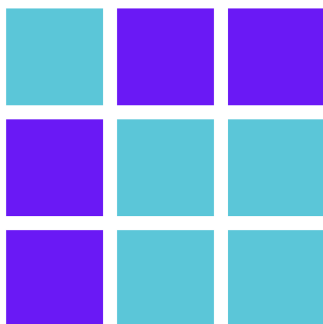
Puzzle 5



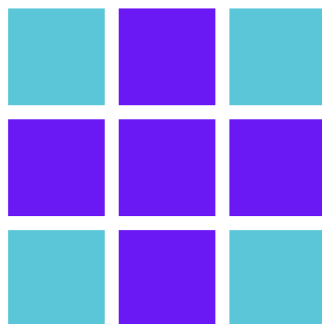
Puzzle 6



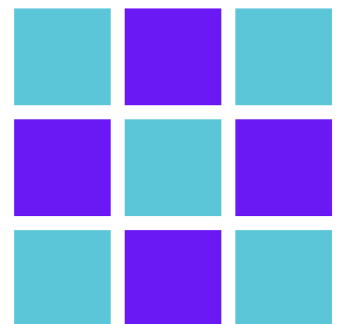
Puzzle 7



Puzzle 8



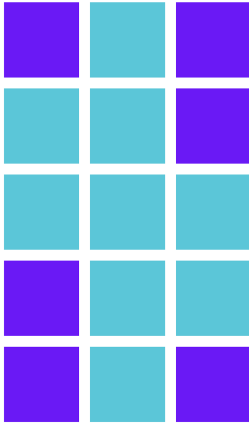
Puzzle 9



Gerrymandering Tasks

- Make 3 groups with 5 squares in each group.
- In each puzzle, 2 of the groups need to be purple groups.
- At least two of the puzzles below are impossible. Which puzzles are impossible, and why are they impossible?

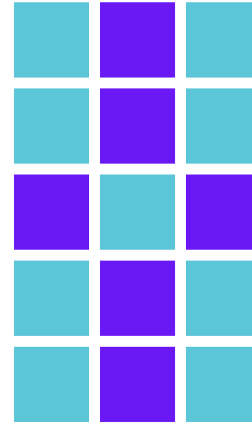
Puzzle 10



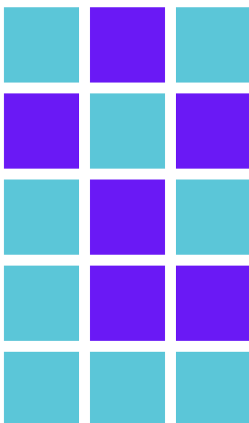
Puzzle 11



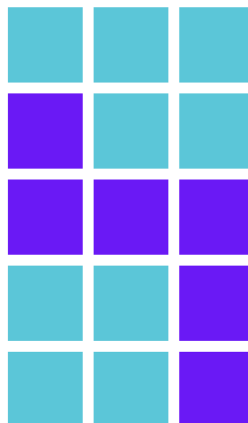
Puzzle 12



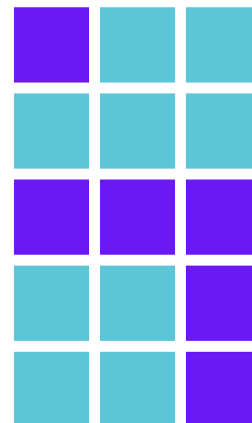
Puzzle 13



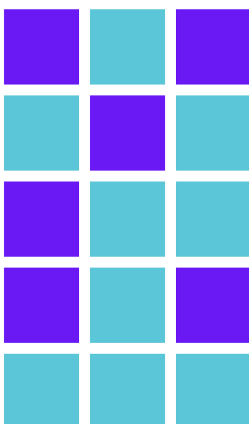
Puzzle 14



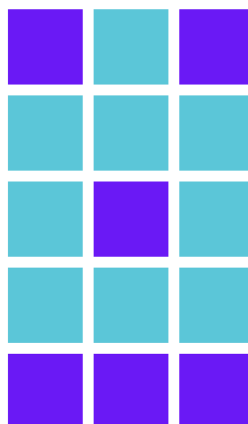
Puzzle 15



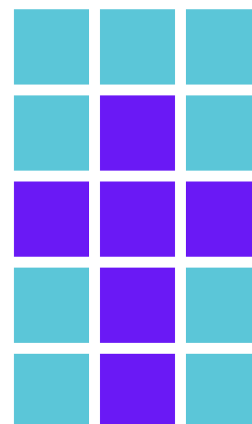
Puzzle 16



Puzzle 17



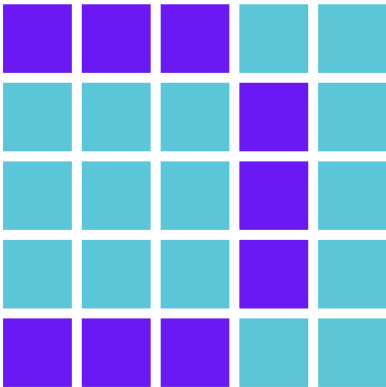
Puzzle 18



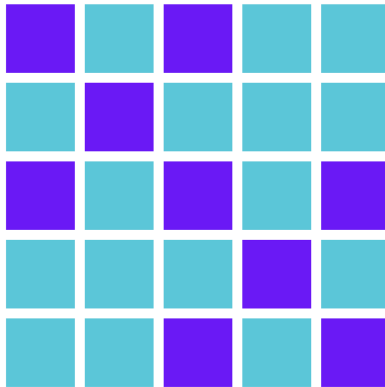
Gerrymandering Tasks

- Make 5 groups with 5 squares in each group.
- In each puzzle, 3 of the groups need to be purple groups.
- At least two of the puzzles below are impossible. Which puzzles are impossible, and why are they impossible?

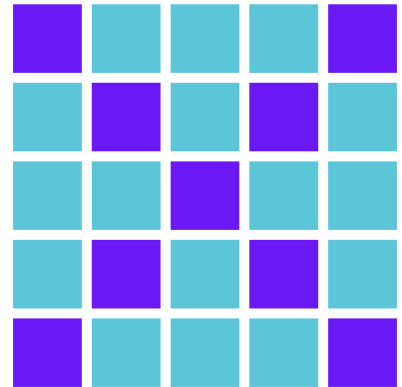
Puzzle 19



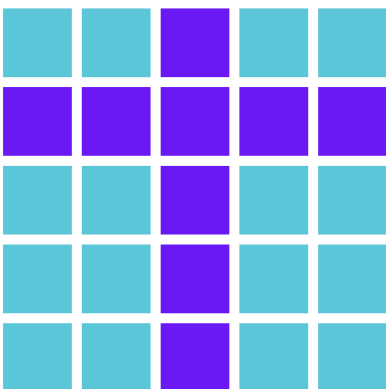
Puzzle 20



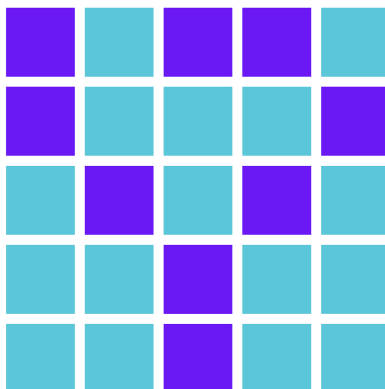
Puzzle 21



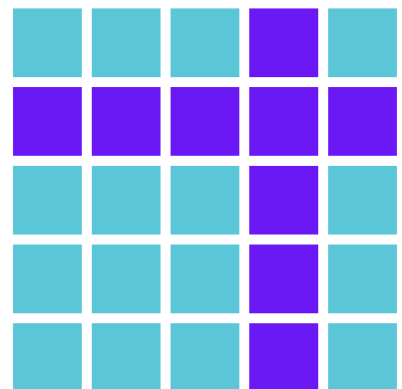
Puzzle 22



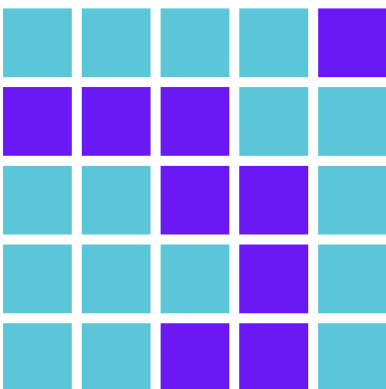
Puzzle 23



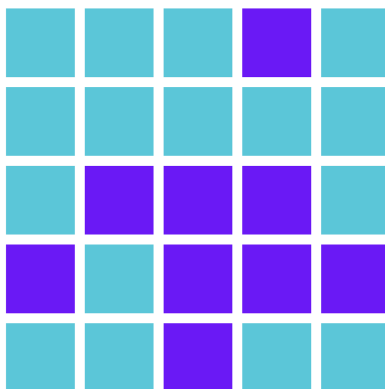
Puzzle 24



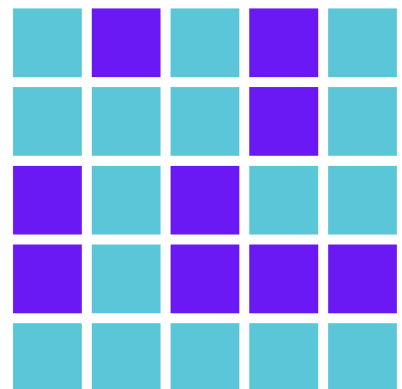
Puzzle 25



Puzzle 26



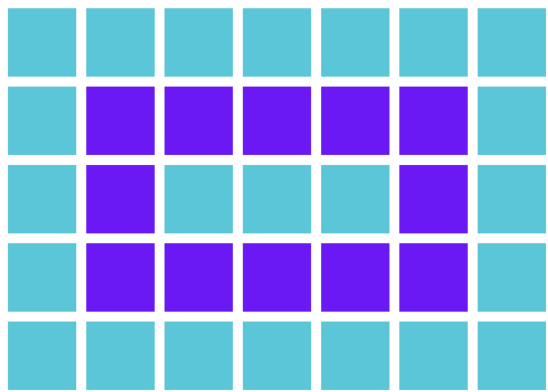
Puzzle 27



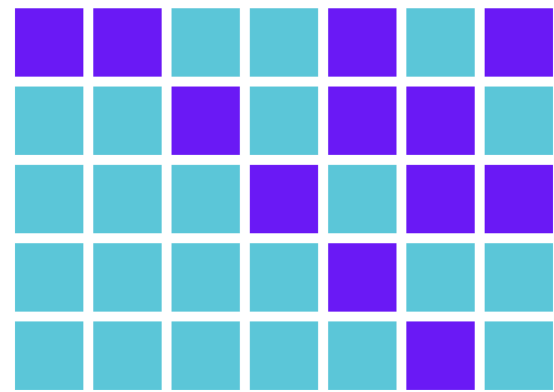
Gerrymandering Tasks

- Make 5 groups with 7 squares in each group.
- In each puzzle, 3 of the groups need to be purple groups.
- At least two of the puzzles below are impossible. Which puzzles are impossible, and why are they impossible?

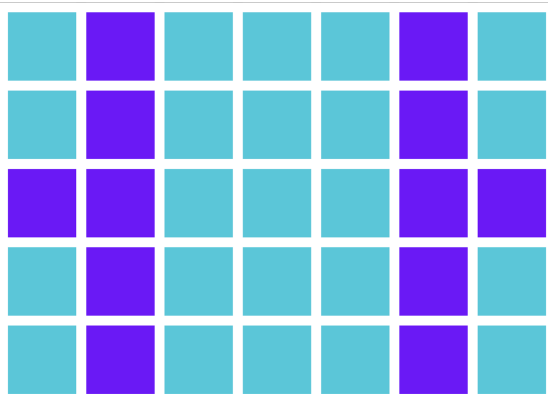
Puzzle 28



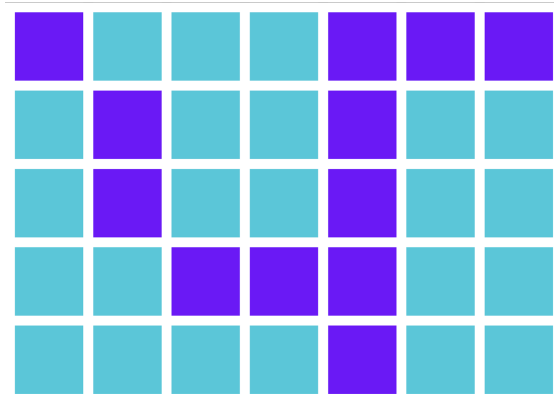
Puzzle 29



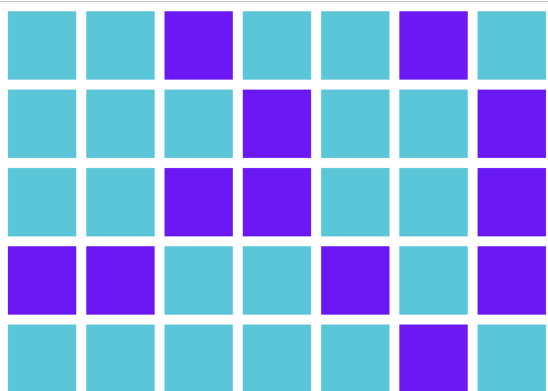
Puzzle 30



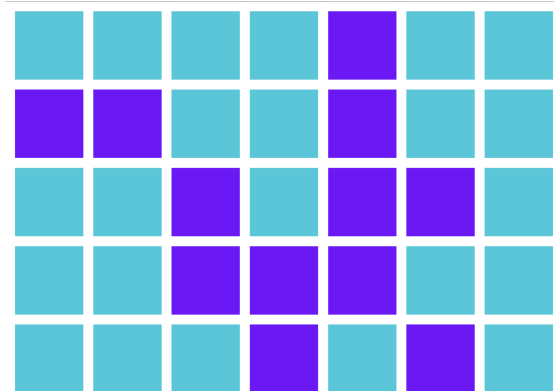
Puzzle 31



Puzzle 32

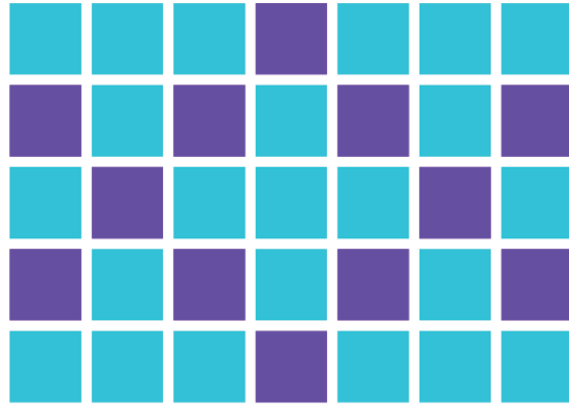


Puzzle 33





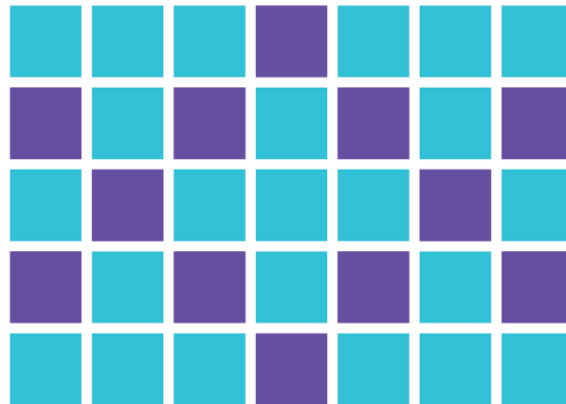
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