General Format

This Mounting Mayhem round is about a type of puzzle called a **Fillomino**.

You will have 15 minutes to read through this rules document, and then 60 minutes to complete the puzzles. The puzzles are divided into four sections:

- **Section 1 (Standard Filllominoes)**: 4 puzzles;
- **Section 2 (Non-Square Grids):** 3 puzzles;
- **Section 3 (Even/Odd):** 3 puzzles;
- **Section 4 (Palominoes):** 3 puzzles.

No partial credit will be given to unfinished or incorrect puzzles, even if the errors are minor. A puzzle will only be considered finished if every cell is filled with a value. Any puzzle with empty cells will not be eligible for credit.

It is highly recommended that all members of your team read through all of the provided rules, tips and examples.

Interface

You should have received a link to a spreadsheet on Google Sheets containing a copy of the puzzles, though you will not be able to access the file yet. When time starts, you will be granted access to the spreadsheet on Google Sheets (make sure to refresh), and when time concludes, your access will be revoked.

For the Mounting Mayhem round, each puzzle will require that you enter numbers into the cells of a bordered 'grid' in the sheet. To be a finished and correct puzzle (and to receive the points), every cell must contain exactly one number, the value of which will be determined by the Fillomino rules specified on the following pages. As you fill in the cells on the sheet, they will change color so that you may easily identify the patterns that emerge on the grid. There is a button to toggle between colorblind-friendly cell coloring and standard cell coloring. Each puzzle also has a "clear" button, in case you got stuck and want to start over.

Additionally, each puzzle on the sheet will have a number of points associated with the puzzle above it, and the number of total squares present in the puzzle below it. You can use this information to inform your strategies in this round.

1 Introduction to Fillomino

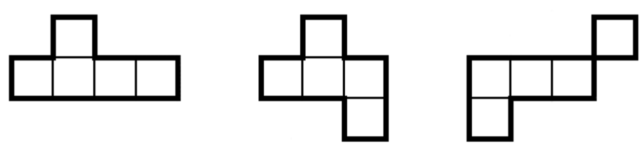
Standard Fillomino is played on a rectangular grid. Each puzzle will contain some cells already correctly filled as a starting point for your solution.

2	6		2	
1		1		6
	3		2	3

The objective of Fillomino is to fill the remaining cells with numbers so that the finished grid obeys certain rules described below.

Polyominoes

First, let's define a *polyomino*. A polyomino is a geometric figure that consists of a group of squares connected together by their edges. The size of a polyomino is the number of squares it is made of. Additionally, we can refer to an polyomino of a given size by its number (e.g. a 1-omino, 2-omino, 3-omino, etc.)
For example, the first 2 figures are both polyominoes of size 5. The last figure is not a polyomino because the square in the upper right corner is not connected by an edge.



The Rules of Fillomino

Your objective is to fill the grid with numbers such that clusters of the same number form polyominoes. The placement of the numbers depends on the following conditions:

- **Given Numbers Rule**
  Each number is part of a polyomino of that size.
- **Equal Sizes Cannot Touch**
  No two polyominoes of matching size share a edge.

It is possible for a polyomino in the solution to have no given number clue at all – these are called "hidden polyominos". It is also possible for two given squares with matching numbers to belong to the same polyomino.
All puzzles in the Puzzle Round have UNIQUE solutions that can be deduced logically. If you believe that there are multiple solutions, it is likely that you have misinterpreted the rules of the puzzle.

Worked Example

Let's go back to our original Fillomino and try to find its unique solution. Along the way, we will demonstrate many of the classic techniques used in solving Fillomino puzzles.

2	6		2	
1		1		6
	3		2	3

One place to start is to find polyominos that must extend in a certain way. For example, the 2 in the top left and the 3 in the bottom right are both forced. Furthermore, once the 3 in the bottom right is placed, its neighboring 2 is also forced.

2	6		2	
2				
1		1		6
			3	3
	3	2	2	3

Now examine Row 4, Column 3. It is contained in some polyomino. Since this cell is touching existing polyominos of sizes 1, 2, and 3, its size must be at least 4. This "hidden polyomino" extends into the cell to its left.

2	6		2	
2				
1		1		6
	x	x	3	3
	3	2	2	3

In particular, the 3 in the bottom left is now forced, pushing our hidden polyomino up between the given 1 clues.

2	6		2	
2	x			
1	x	1		6
3	x	x	3	3
3	3	2	2	3

There isn't much we can do now, because our gray hidden polyomino could, in theory, join with the 6 in the first row. To make progress, notice that the 6 in the fifth column needs to escape from the cul de sac of white cells in the top right. In particular, it must take the third and fourth cells in row 2.

2	**6**		**2**	
2	x	6	6	
1	x	**1**		**6**
3	x	x	3	3
3	**3**	2	**2**	**3**

Now the two 6s must connect to each other and hence cannot connect with our hidden polyomino.

2	**6**	6	**2**	2
2	4	6	6	
1	4	**1**		**6**
3	4	4	3	3
3	**3**	2	**2**	**3**

Finally, observe there are two placements for the last cell in the 6-omino: Row 2, Column 5 or Row 3, Column 4. However, the first option is impossible: it would place two 1-ominos next to each other in Row 3, which is impossible by **Equal Sizes Cannot Touch**. Hence, the 6-omino takes Row 2, Column 5 and the rest of the puzzle finishes.

2	**6**	6	**2**	2
2	4	6	6	1
1	4	**1**	6	**6**
3	4	4	3	3
3	**3**	2	**2**	**3**

The rest of the Mounting Mayhem round builds on the mechanics of the Fillomino, so it is a good idea for all members of the team to familiarize themselves with the rules in this section.

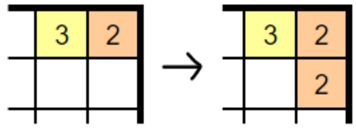
Tips

We used a wide variety of strategies above, now let's expand on those and and explain a few others:

- **Corralling**

  Sometimes, a partially filled polyomino will only have 1 way to expand.

  For example, consider the following configuration:

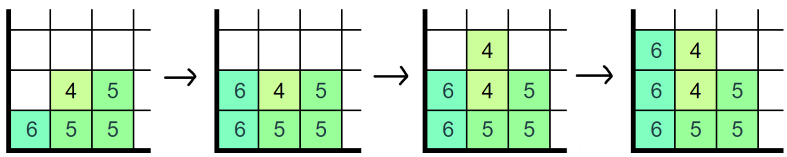


The given clue 2 is surrounded on 3 sides. A polyomino of size 2 needs to have the squares connected by an edge, and there is only one available edge to connect to. So, the cell below belongs to the same polyomino, and is filled in with a 2.

Corralling has many applications, two of which are explained below.

- **Partial Filling**
Often times, partially filling out polyominoes can help constrain the sizes and directions of other polyominoes.

  For example, here's a possible usage of partial filling.

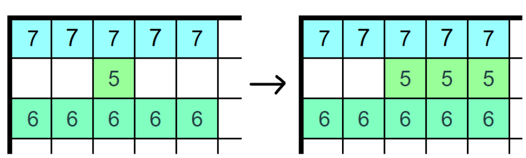


  In the first step, 6 gets corralled upward. Then, 4 gets corralled upward because of that. Finally, 6 get corralled upward again.

  Even though we don't know the full shape of the 6-omino and the 4-omino, filling in the 6-omino partially did help expand them.

- **Overflow**
Sometimes, a partially filled polyomino might be trapped with a few ways to go. If one of the ways does not have room for the entire polyomino, then you know that it will have to expand out another way.

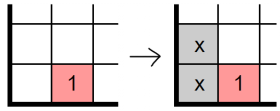
  For example, here's a possible way this can be used.



  We know that when expanding the 5-omino, it won't fit completely to the left of the given clue. This means that it must expand to the right.

  Notice that even though we don't know if there might be hidden polyominoes in the left 2 blank squares, we can still partially fill in the 5-omino.

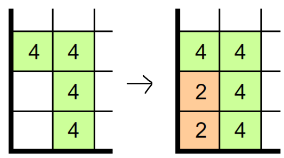
- **Hidden Corralling**
Not only can you corral normal polyominoes, you can also corral hidden polyominoes!



Let the polyomino in the corner have size X. Note that $X > 1$ because of **Equal Sizes Cannot Touch**, so whatever X is, it will get corralled upward because it is surrounded on 3 sides. So, the square above must be part of the same polyomino.

- **Filling in the Gaps**
  Don't just try to fill out existing ominos. Consider whether a hidden polyomino can fit in a space, and whether filling different polyominoes into an empty space will violate any rules.

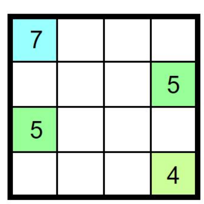
  For example,



  The empty spots can be filled with either 2 1-ominoes, or 1 2-omino. 2 1-ominoes would violate **Equal Sizes Cannot Touch**, so it must be a 2-omino.

- **Count the Squares**
  Try to count the number of total squares available and the number of squares that are taken up by the given clues in the puzzle. This might help you identify hidden polyominoes, or help you determine whether two given clues are part of the same polyomino or not.

  Consider this:



  There are 16 squares total. Since $16 = 7 + 5 + 4$, we know that in our solution, we can only have 1 7-omino, 1 5-omino and 1 4-omino. So, the given clue 5s must be connected, and there cannot be any hidden polyominoes.

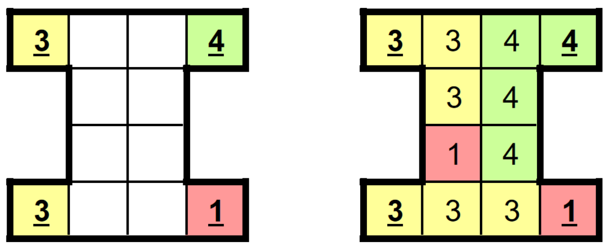
- **Guess and Check**
  If you are stuck, you might want to resort to guessing and checking. While it might be helpful to assume things sometimes, you will usually find yourself spending a lot more time using this strategy. Guessing and checking will most likely lead you to getting stuck. As a reminder, all puzzles on the Mounting Mayhem round have a logical route to a solution. Employ this strategy, but with great caution.

2 Non-Square Grids

Non-Square Grid Fillomino has the same rules as standard Fillomino, except that the grid is not square.

Example

Here is an example Non-Square Grid Fillomino, along with its unique solution:



Tips

Since Non-Square Grid Fillominos have the same rules as standard Fillomino, all the tips from the previous section apply here, too. There is one new tip to consider as well.

- **Geometry Constraints**
  Keep the shape of the grid in mind! Puzzles may rely on narrow passageways in ways that square grids do not allow.

3 Even/Odd

In addition to the rules of standard Fillomino there is one new rule:

One Big Even, One Big Odd
All the odd-numbered squares must form a single polyomino called the **Odd Polymino**, and all the even-numbered squares must form a single polyomino called the **Even Polyomino**.

Worked Example

Here is an example Even/Odd Fillomino.

2		
1		
2		

First, **corralling** tells us that the given clue 2's can only be expanded to the right.

2	2	
1		
2	2	

Now, **One Big Even, One Big Odd** says that the even numbered squares must form a polyomino. **Counting the Squares** shows that we have 4 squares left to use.
The 2-ominoes must be connect by another even polyomino to satisfy **One Big Even, One Big Odd**. They can't be connected by 2-ominoes because of **Equal Sizes Cannot Touch**, so they must be connected by a 4-omino.

2	2	4
1	4	4
2	2	4

Tips

All the tips from standard Fillomino still apply.

- **Even/Odd Empty Space Division**
  In Even/Odd Fillomino, making sure that **One Big Even, One Big Odd** is satisfied is very important. It can help to force numbers when an empty space. This is shown in the example above, when choosing to make all 4 squares belong to a 4-omino.

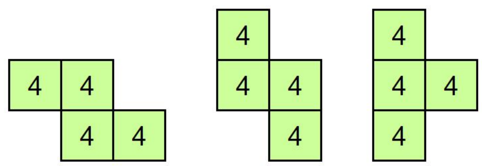
4 Palomino

In addition to the rules of standard Fillomino, there is one new rule:

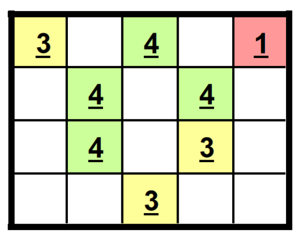
Matching Polyominoes
Each polyomino must have EXACTLY ONE matching polyomino (known as its *pal*) somewhere on the grid. Two polyominoes are pals if they can be flipped and/or rotated to form the other.

Remember, this is EXACTLY ONE. If there were 4 of one shape of polyomino on the board, that would not be a valid solution.

As an example, the first two polyminoes below are pals, but the last is not pals with the first two.

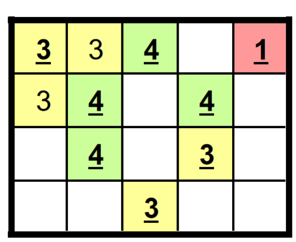


Worked Example



First, we **Count the Squares**. There are 20 squares total in this grid. Since each polyomino must have a matching one, the distinct polyomino shapes must have a combined size of 10. We already know that we will have polyominoes of size 1, 3, and 4, which means that the final type of polyomino will be a 2-omino. That is, our solution will have 2 matching 1-ominoes, 2 matching 2-omiones, 2 matching 3-ominoes and 2 matching 4-ominoes.

So, **Hidden or Joined Polyominoes** says that the 3s at the bottom must connect to form a single L-shaped 3-omino. This means that the 3-omino at the top left corner needs to be an L-shaped 3-omino too. It will be like:



Now, we know that the empty square in row 2, column 3 cannot contain a 4, because of **Equal Sizes Cannot Touch**. So, combining this with **Corralling** tells us that the given 4s in the top right corner must form the following:

3	3	**4**	4	**1**
3	**4**		**4**	4
	4		**3**	
		3		

Because the other 4-omino needs to match this one, and **Equal Sizes Cannot Touch**, we know that they must form a 4-omino like this:

3	3	**4**	4	**1**
3	**4**		**4**	4
4	**4**		**3**	
4		**3**	3	

Now we can fill in the rest with our two 2-ominoes and one 1-omino.

3	3	**4**	4	**1**
3	**4**	2	**4**	4
4	**4**	2	**3**	2
4	1	**3**	3	2

Tips

All the tips from standard Fillomino apply as well.

- **No Lonely Polyominos**
  Keep track of what polyominos you only have 1 of on the board, and save space to place a matching one on the board.

- **Counting with Matching Pairs**
  Each Polyomino must have a matching pair. So, while **Counting the Squares**, divide the total number by 2 to obtain the total size of the distinct polyominos. This is shown in the example above on the first step, where we determine the types of polyominos we need.

- **Small Scarcity**
  Unlike classic Fillomino, small-sized polyominos are rare in this variant! Only one pair of 1-ominos and one pair of 2-ominos is allowed. Remember, each polyomino has EXACTLY ONE pal.

Wrapup

Great! You should be all set for the Mounting Mayhem Round now. If the reading period is not over yet, consider rereading key sections, looking through examples or discussing strategies with your team!

Good luck!