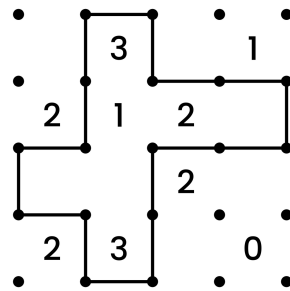
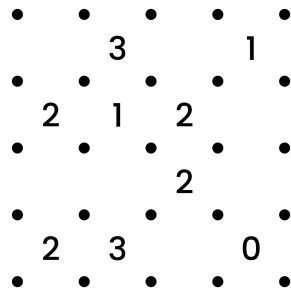


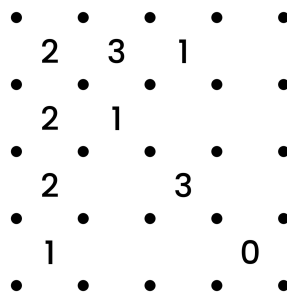
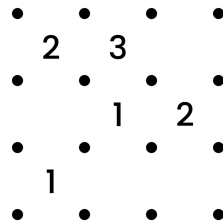
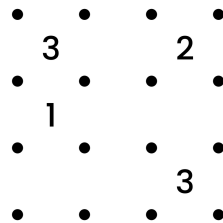
UW Math Circle

Week 1 – Slitherlink

Slitherlink is a puzzle where the goal is to draw **one loop** on a grid, with no self-intersections. If a grid cell has a number in it, that indicates how many sides of that cell should be in the loop. Take a look at an example puzzle (on the left), and the sample solution (on the right).

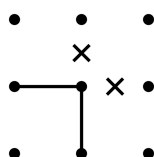


1. Give it a try! Try to solve these puzzles.

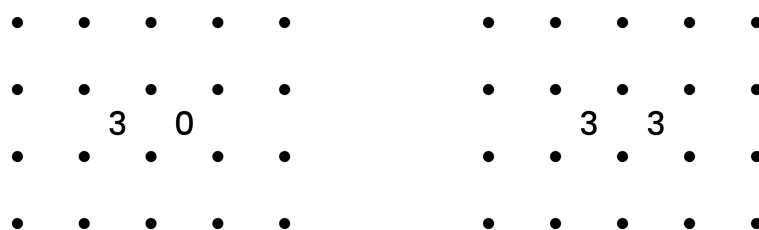
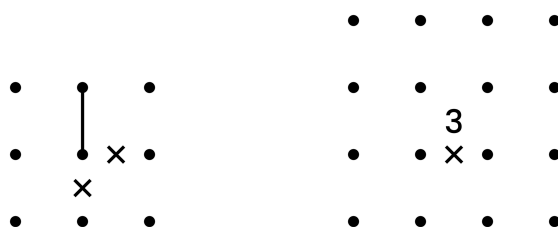


Let's try to devise some strategies for Slitherlink.

2. Explain why in any Slitherlink solution, every grid dot must have either 2 edges or 0 edges drawn to it.
3. A common notation is draw a small X where you know it's not possible to put an edge. For example, if you have the following two edges, by the above observation, you can draw the following two X's.



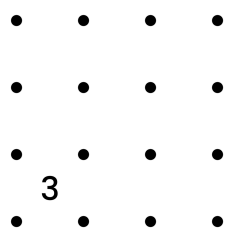
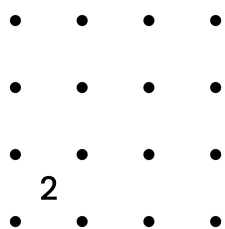
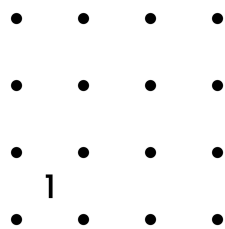
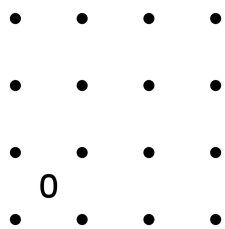
An edge or X is called *forced* if it *must* be true in any solution. In other words, it's not a guess. Draw all forced edges and X's in the below situations. Leave the edges that are still unknown blank.



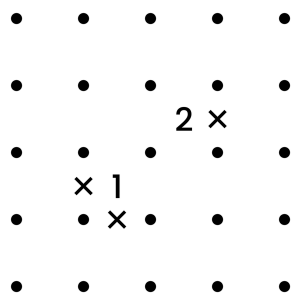
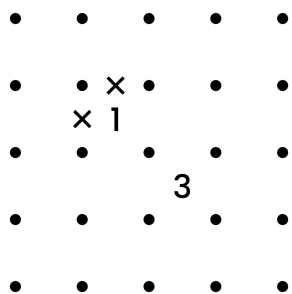
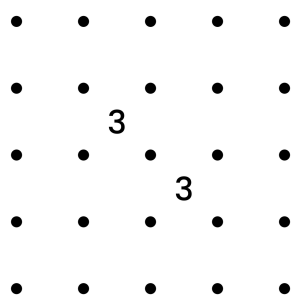
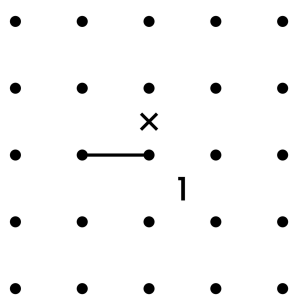
4. Why is it helpful to consider forced edges and X's when solving Slitherlink puzzles?

 **Stop here.** Request the next page from your instructor when your group is done.

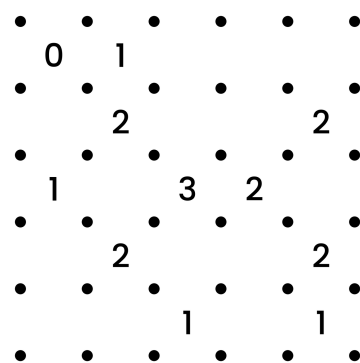
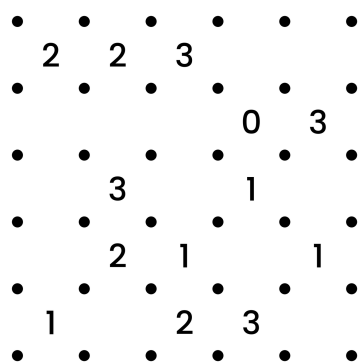
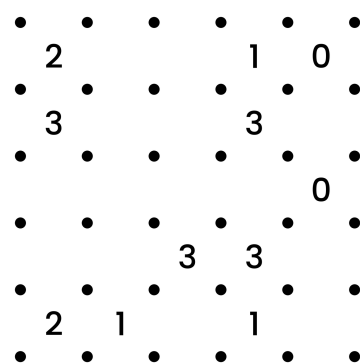
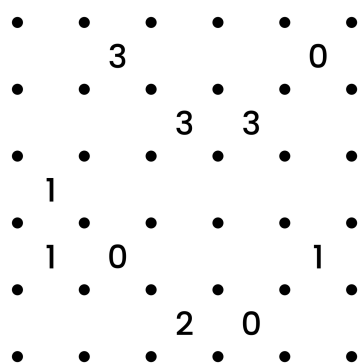
5. Let's keep going! Again, draw all forced edges and X's in the below situations. Each situation below represents the bottom-left corner of the puzzle.



6. Draw all forced edges and X's in each of the more complicated situations below.



7. Use what you've learned to solve the following Slitherlink puzzles. Remember: draw as many forced edges and X's as you can, in order to avoid guessing and having to backtrack if your guess was wrong!



8. A Slitherlink competition will take place in the last 20-ish minutes of Math Circle today! You and your partner will work as a team against others in the class. The competition will have 3 rounds. Each round will work as follows:
- Teams will have 2 minutes to come up with a Slitherlink puzzle on a 5×5 grid. You should make it as difficult as you can, but make sure that at least one solution exists!
 - We'll randomly distribute your puzzles among the teams. Each team will then have 4 minutes to solve the puzzle they receive, though faster is better.

At the end, the team that wrote the hardest puzzles (i.e. others took the longest time to solve them) and the team best at solving puzzles (i.e. took the shortest time to solve their puzzles) will win prizes! Take some time now to practice writing and solving puzzles.

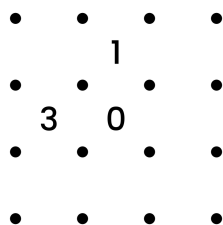
(If you get a puzzle that you suspect is impossible to solve, let us know and we'll check it. If it's really impossible, it'll count as your solve in 0 seconds and the team who wrote it will be disqualified from winning the prize for writing the hardest puzzles.)



Stop here. Request the next page from your instructor when your group is done.

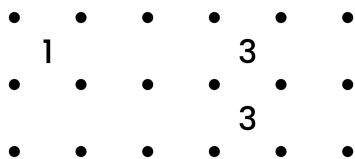
In the following problems, we'll explore when a Slitherlink puzzle has no solutions or multiple solutions.

9. In the below puzzle, find two adjacent points that are simultaneously both forced to be an edge, and forced to be an X. (Thus, no solution is possible.) Would this strategy work for every puzzle with no solution?

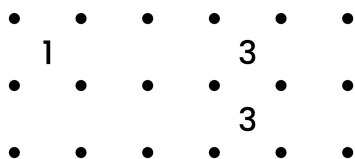


10. (a) Explain why in any Slitherlink solution, every row (of vertical edges) and every column (of horizontal edges) must have an even number of edges.

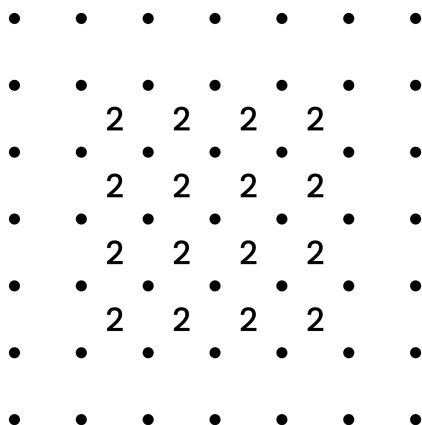
- (b) Use this observation, explain why the following puzzle has no solution.



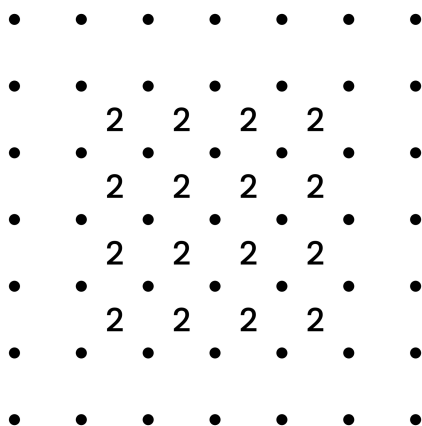
- (c) Imagine that this puzzle was actually wrapped around a cylinder, so that one grid space to the left of the leftmost 3 dots, it wraps around to the rightmost 3 dots (like in the world of Pac-Man). Show that on a cylinder, the puzzle does have a solution! (You're still looking to draw a single loop—something that you can draw on the cylinder without lifting your pencil and ending where you began—with no self-intersections.)



11. (a) (Challenge) Explain why the following puzzle has no solution.



- (b) Find a way to change one of the 2's into a 1, so that the puzzle has a solution.



12. Create a Slitherlink puzzle where every cell has a number, but there are still at least two solutions. (Hint: you can do it with just a 2×2 grid of cells, or in other words a 3×3 grid of dots!)