

Jumping Julia: From Life Size Maze Puzzles to Graph Theory

Help Julia get from **start** to **finish**: begin on the square in the upper left. Make a series of jumps that will take you to the square marked **finish**. The number in each square indicates how far you move—horizontally or vertically (your entire move must be horizontal or vertical), not diagonally—when you bounce off the square.

Maze by Robert Abbott www.logicmazes.com Design by thecreativefold.com
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 Julia Robinson Mathematics Festival (jrmf.org) supports quality organized events that engage K-12 students to explore the richness and beauty of mathematics.

Maze #1

S	3	2	2	1
3	2	1	3	
1	1	1	1	
1	3	1	Goal	

Julia Robinson Mathematics Festival

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Lauren Rose, Bard College rose@bard.edu
 Daniel Hodgins, Auburn University

What is Jumping Julia?

Jumping Julia is a **maze puzzle** popularised by Robert Abbott, adapted by the Julia Robinson Math Festival.

Ways to play:

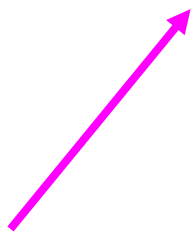
- ❖ On the app:
jrmf.org/puzzle/jumping-julia/
- ❖ At the Julia Robinson Math Festival, today 12-3 in Room 146BC
- ❖ At the SIGMAA-REC/MCST booth #523 in the exhibition center!
- ❖ Make your own puzzles!



How do you play Jumping Julia?

1. Numbers indicate how many jumps you must go, either vertically or horizontally.
2. No diagonals.
3. Begin at the start box
4. End at the goal.

Start here



Maze #1

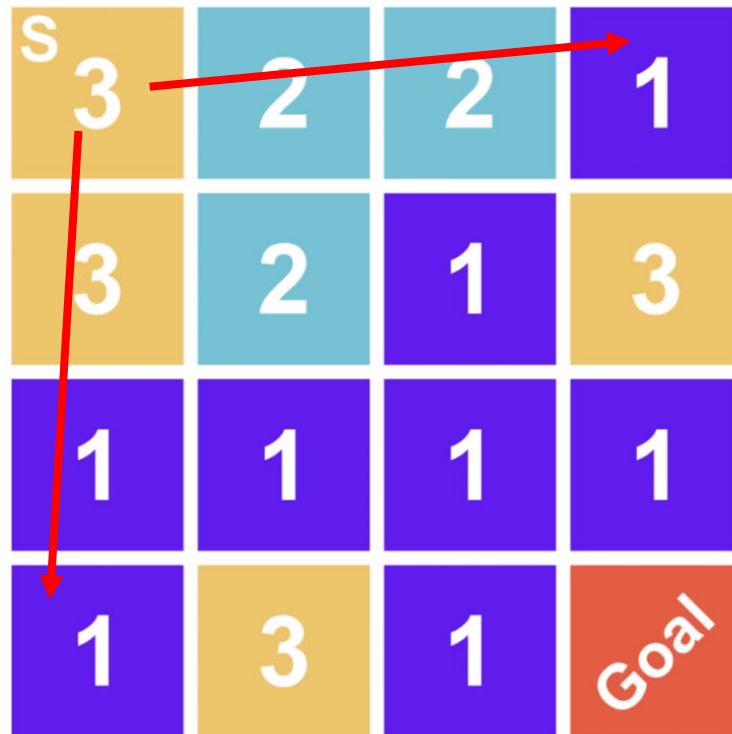


How do you play Jumping Julia?

1. Numbers indicate how many jumps you must go, either vertically or horizontally.
2. No diagonals.
3. Begin at the start box
4. End at the goal.

Start here

Maze #1



Try it yourself: Start in the upper left and end at the 

Puzzle 1

start here



Puzzle 2



Try it yourself

Puzzle 1



Questions:

1. What strategies did you use?
2. Were you able to solve both puzzles?

Puzzle 2





General Questions



General Questions

1. Is there a solution?
2. Is there a unique solution?
3. Which starting points have solutions?
4. Is there a strategy to solving the puzzles?
5. What percentage of grids have solutions?
6. What percentage of grids have unique solutions
7. What does this have to do with graph theory?

Solution Strategies

- ❖ 1. Work forward.
- ❖ 2. Work backwards.
- ❖ 3. Look for dead ends.

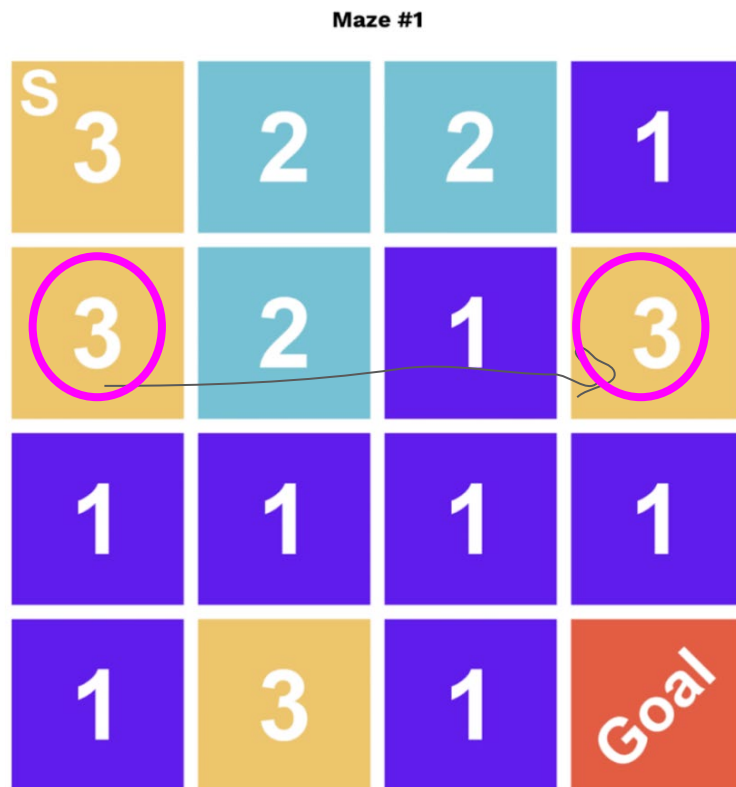
Solution Strategies

- ❖ 1. Work forward.
- ❖ 2. **Work backwards.**
- ❖ 3. Look for dead ends.



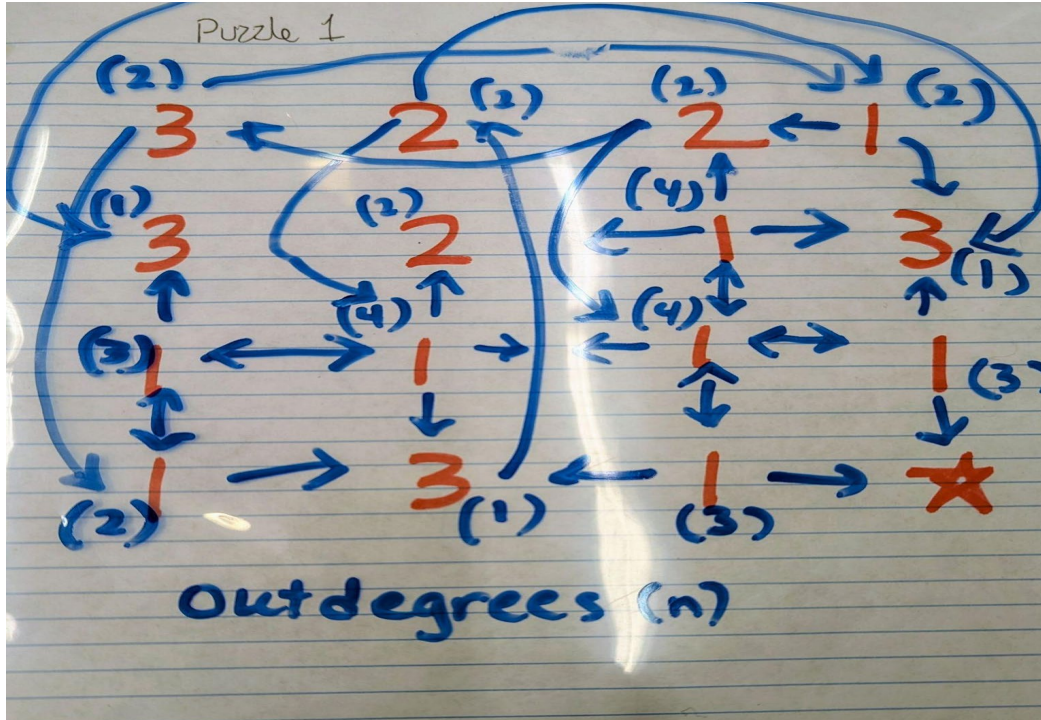
Solution Strategies

- ❖ 1. Work forward.
- ❖ 2. Work backwards.
- ❖ 3. **Look for dead ends.**



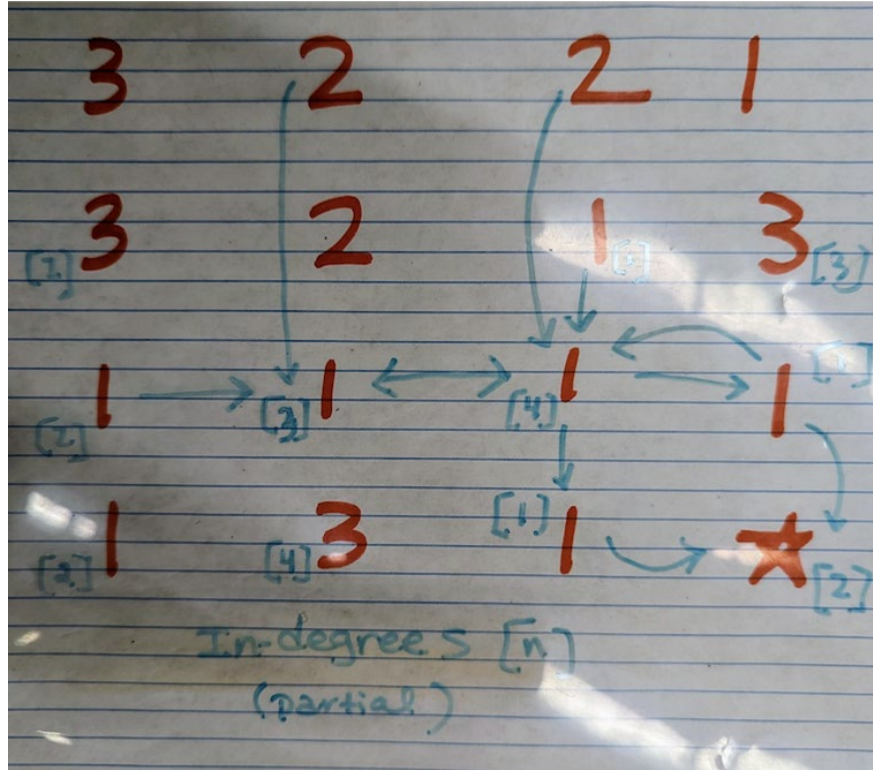
Graph representation

Work forward = **out-degree** of a vertex



Graph representation

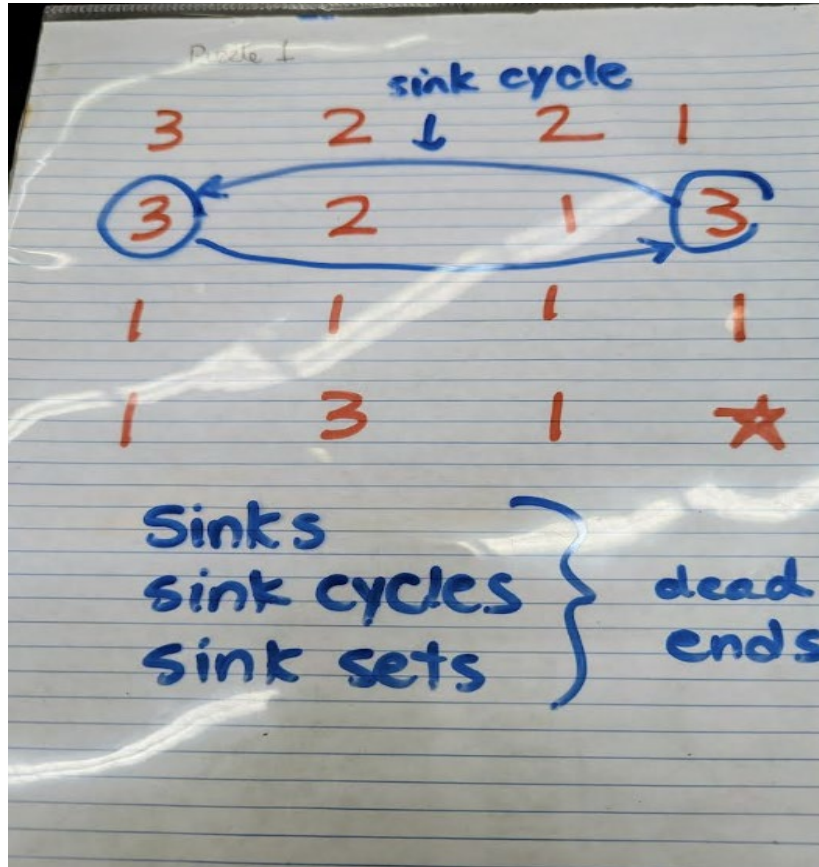
Work backwards = in-degree of a vertex



Graph representation

Look for dead ends:

sinks and sink sets



Graph representation: *Combine techniques*

1. Work forward

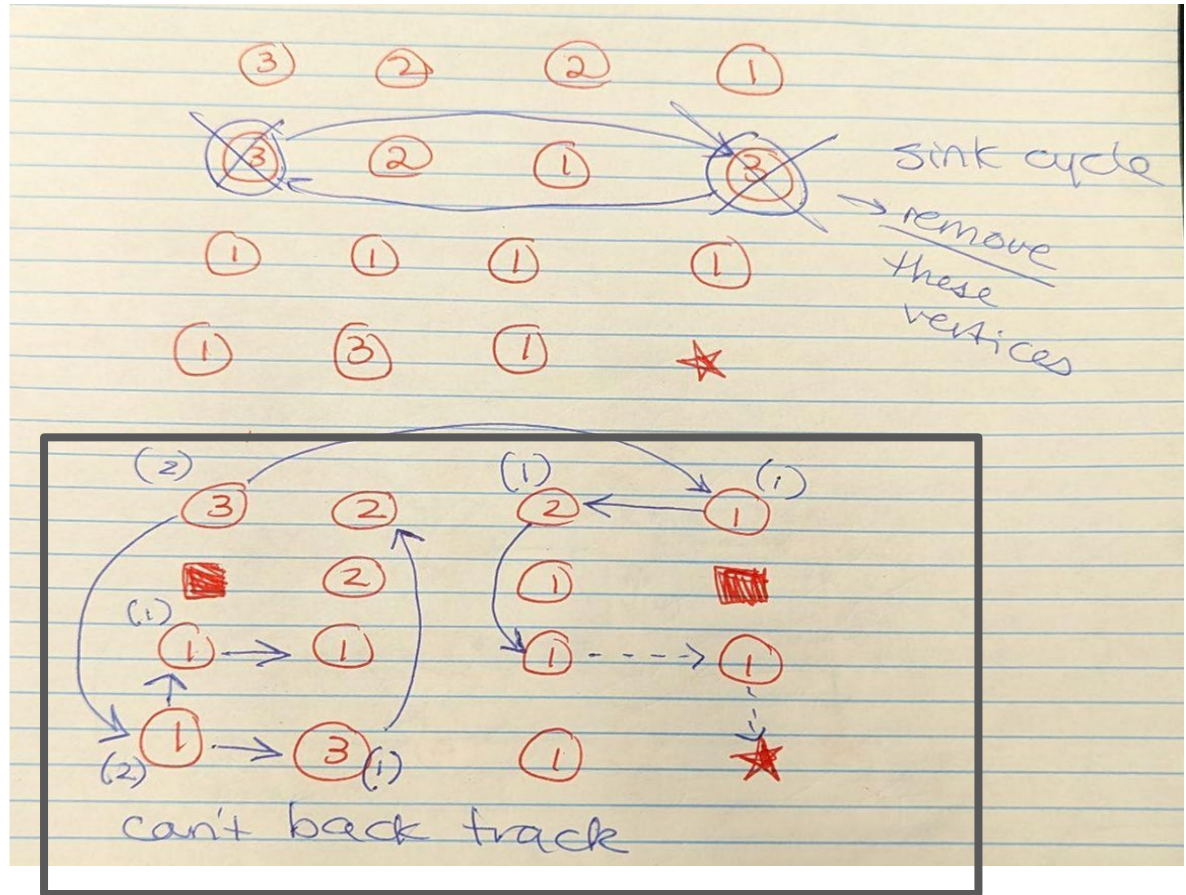
out-degree

2. Work backwards

in-degree

3. Look for dead ends

sinks



Graph representation

Now try puzzle #2

- 1) Dead ends = sinks sets
- 2) Forward = out-degree
- 3) Backwards = in degree

- ❖ Is there a solution?
- ❖ Is there a unique solution?
- ❖ Which starting points have solutions?

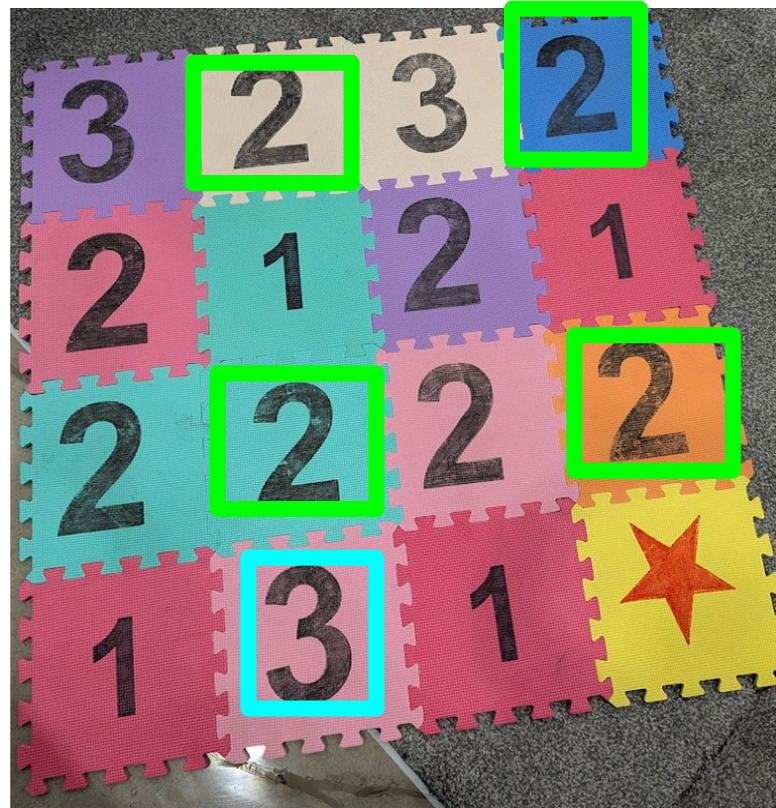


Sink Sets

Now try puzzle #2

- 1) Dead ends = sinks sets
- 2) Forward = out-degree
- 3) Backwards = in degree

- ❖ Is there a solution?
- ❖ Is there a unique solution?
- ❖ Which starting points have solutions?

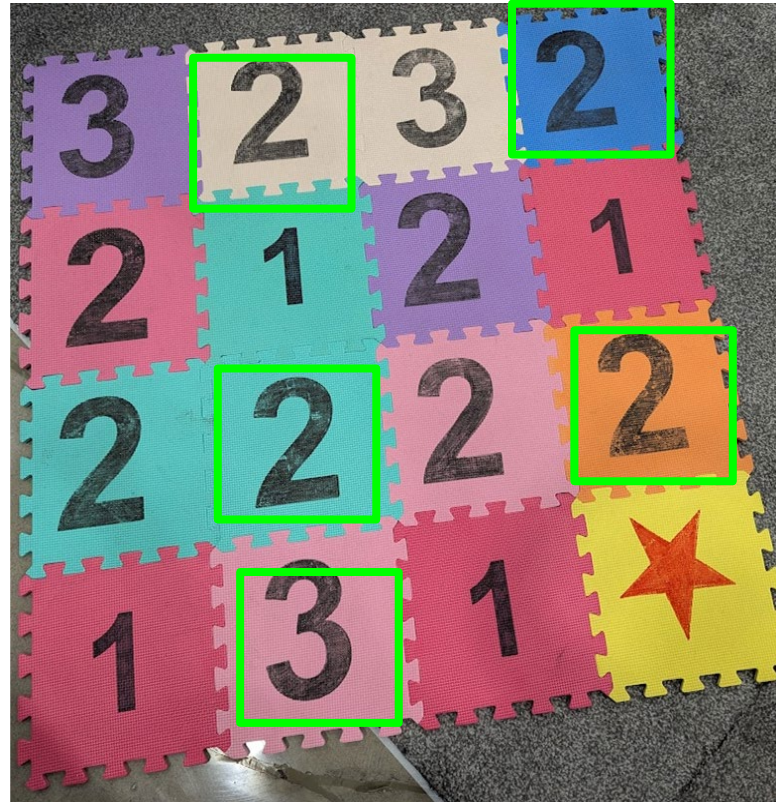


Sink Sets

Now try puzzle #2

- 1) Dead ends = sinks sets
- 2) Forward = out-degree
- 3) Backwards = in degree

- ❖ Is there a solution?
- ❖ Is there a unique solution?
- ❖ Which starting points have solutions?

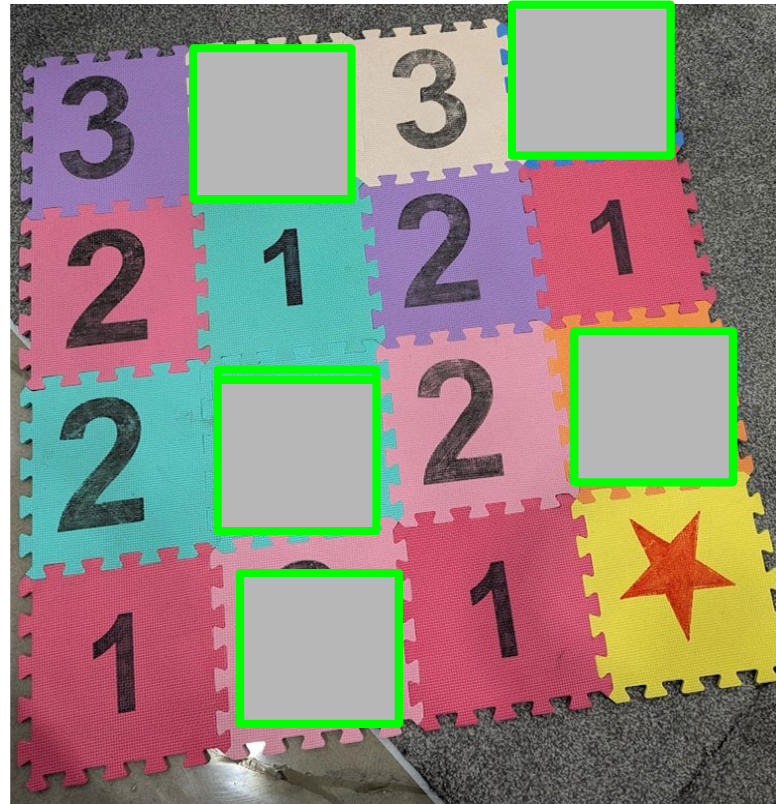


Sink Sets Removed

Now try puzzle #2

- 1) Dead ends = sinks sets
- 2) Forward = out-degree
- 3) Backwards = in degree

- ❖ Is there a solution?
- ❖ Is there a unique solution?
- ❖ Which starting points have solutions?



More Challenges

- Go to the JRMF session today 12-3.
- Come to the SIGMAA REC/MCST booth #532
- Play online: <https://jrmf.org/puzzle/jumping-julia/>

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Start	4	2	2	3	3
	2	2	2	2	2
	3	2	2	2	2
	1	2	3	2	3
	3	2	2	2	finish

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Start	3	6	4	3	2	4	3
	2	1	2	3	2	5	2
	2	3	4	3	4	2	3
	2	4	4	3	4	2	2
	4	5	1	3	2	5	4
	4	3	2	2	4	5	6
	2	5	2	5	6	1	finish



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