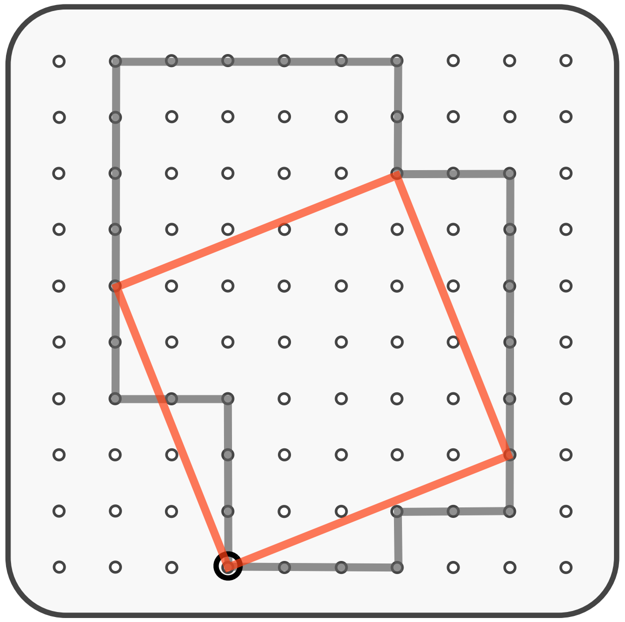
◆ Taxi Cab Squares ◆



Contents

Standards for Mathematical Practice

All MathPickle puzzle designs, including **Taxi Cab Squares**, are guaranteed to engage a wide spectrum of student abilities while targeting the following Standards for Mathematical Practice:

MP1 Toughen up!
This is problem solving where our students develop grit and resiliency in the face of nasty, thorny problems. It is the most sought after skill for our students.

MP3 Work together!
This is collaborative problem solving in which students discuss their strategies to solve a problem and identify missteps in a failed solution. MathPickle recommends pairing up students for all its puzzles.

MP6 Be precise!
This is where our students learn to communicate using precise terminology. MathPickle encourages students not only to use the precise terms of others, but to invent and rigorously define their own terms.

MP7 Be observant!
One of the things that the human brain does very well is identify pattern. We sometimes do this too well and identify patterns that don't really exist.

For the Teacher:

Make your teaching better. Do not look at the answers. The worst thing that can happen is that you'll make a mistake in front of your children. We've all done this. It's okay. By making mistakes in front of the class we model how to fail, stand up, dust ourselves off, and try again. It also makes the class much more exciting!

http://youtu.be/5atNJLGv0y8

Common Core State Standards

Taxi Cab Squares target Common Core State Standards across a wide spectrum of grades. Students from grade 4 through 10 will all take away curricular content from this engaging puzzle:

Grades 4-10

CCSS.MATH.CONTENT.4.G.A.1
Draw right angles, perpendicular and parallel lines. Identify these in two-dimensional figures.

CCSS.MATH.CONTENT.6.G.A.1
Find the area of polygons.

CCSS.MATH.CONTENT.6.G.A.3
Draw polygons in the coordinate plane.

CCSS.MATH.CONTENT.7.G.A.2
Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions.

CCSS.MATH.CONTENT.HSG.MG.A.3
Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints)

http://www.corestandards.org/Math/Practice/

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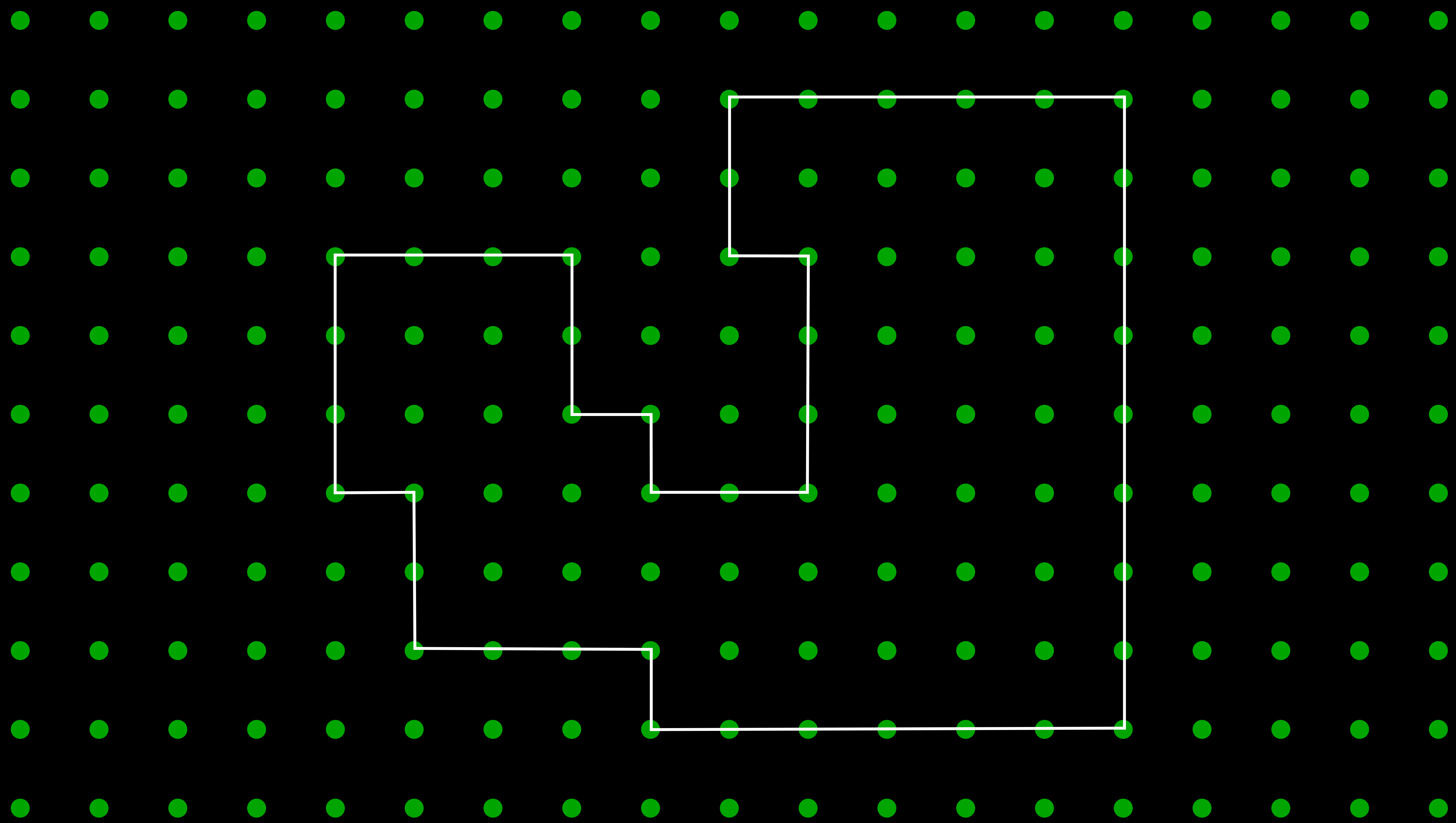

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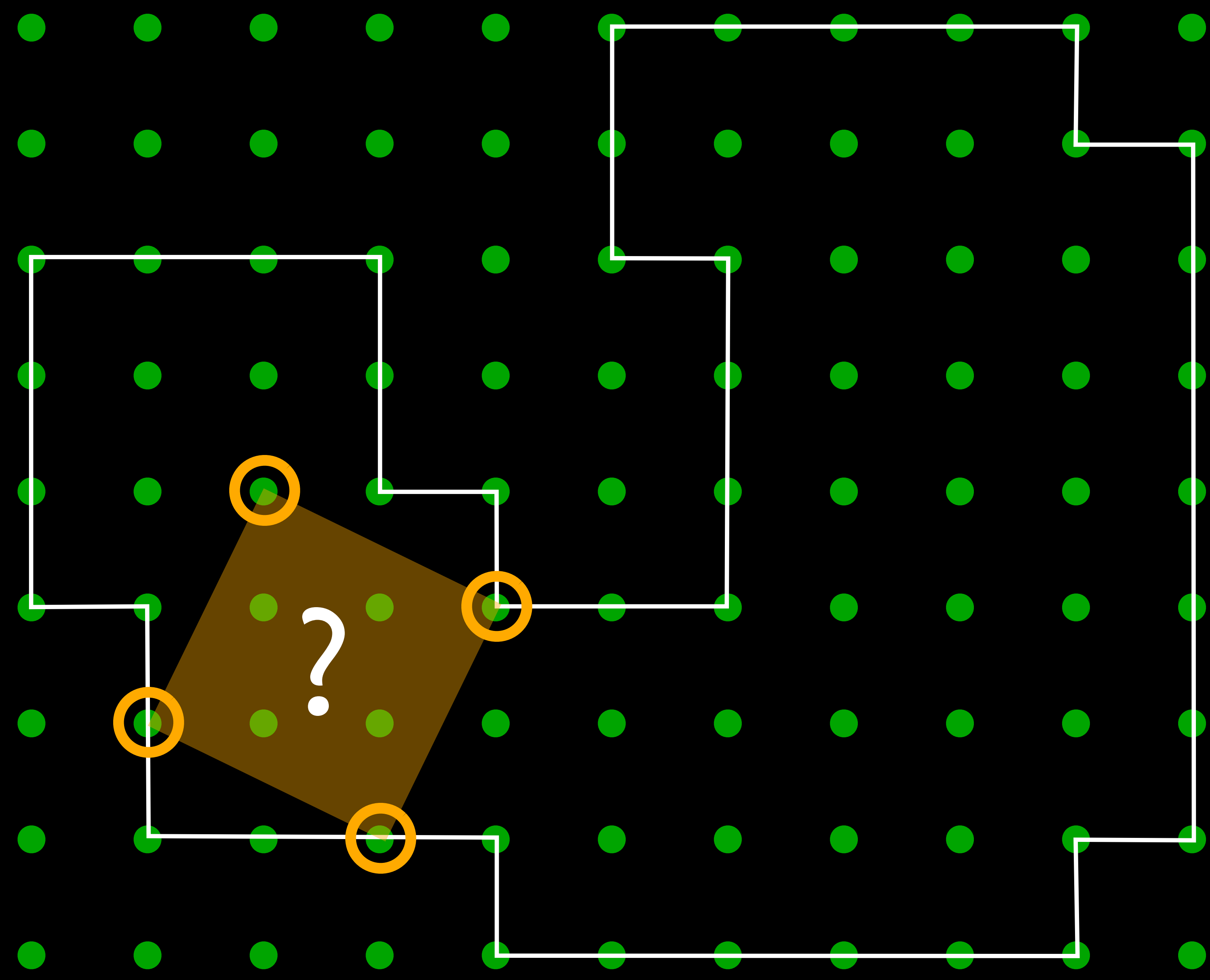

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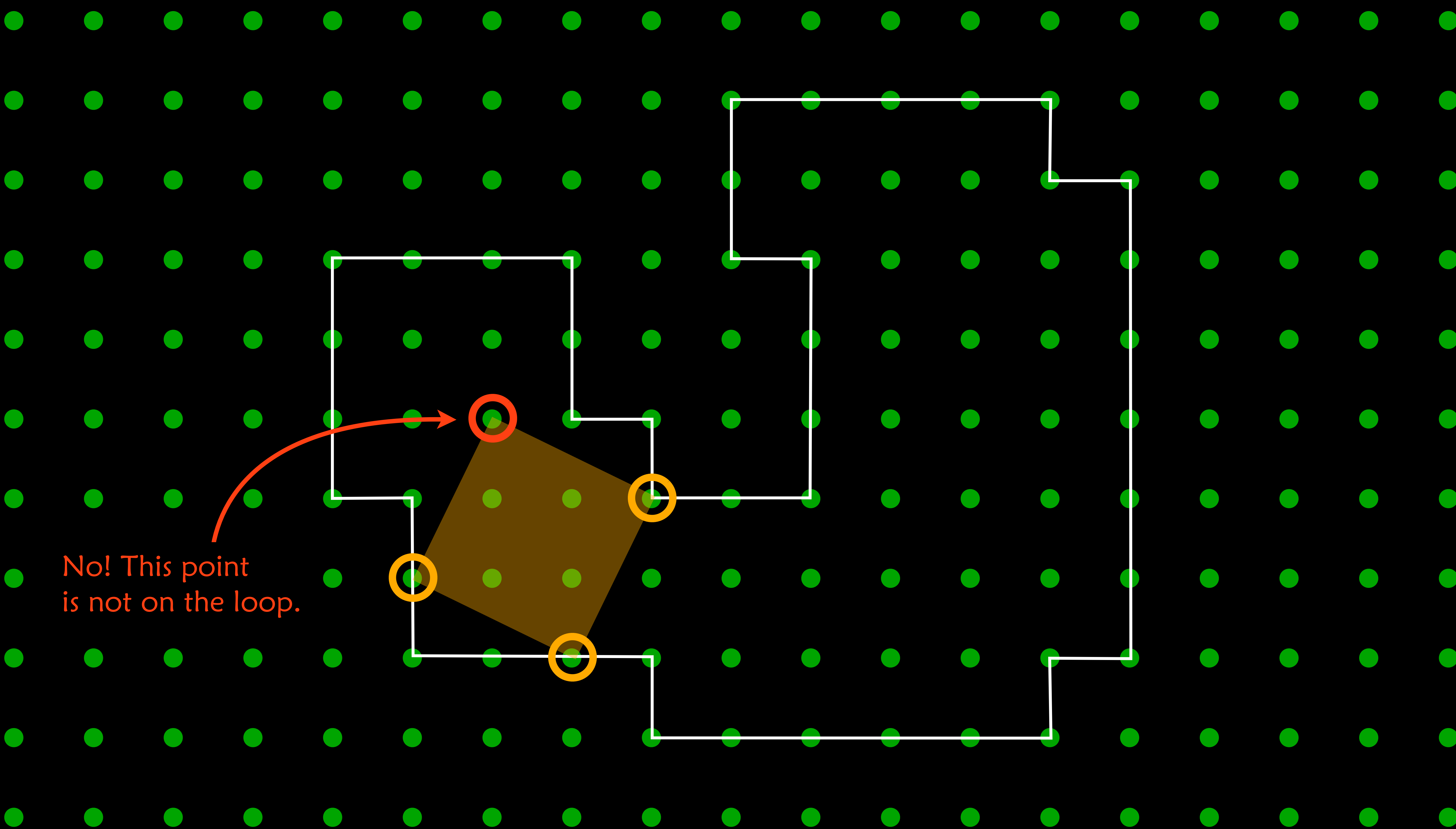

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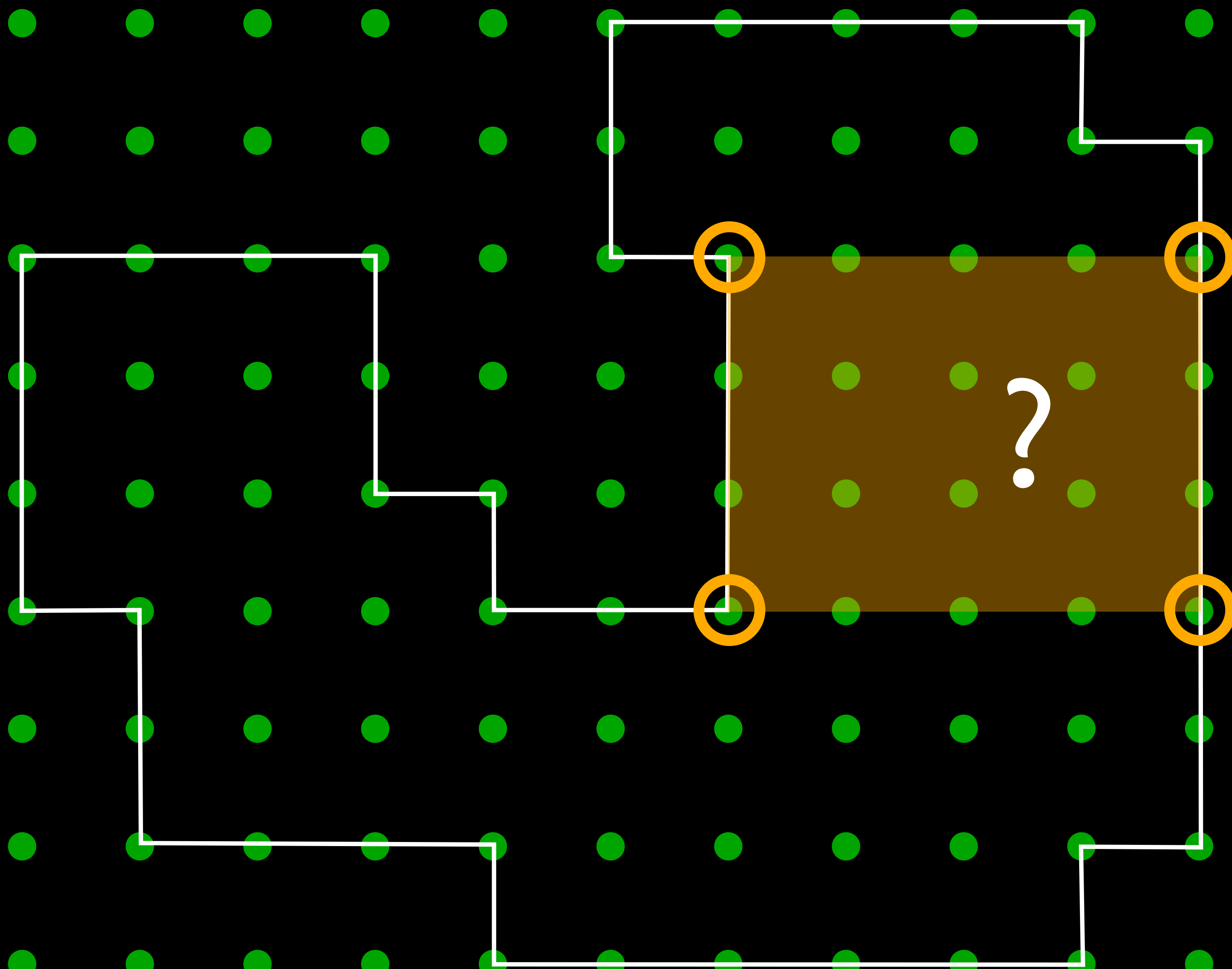

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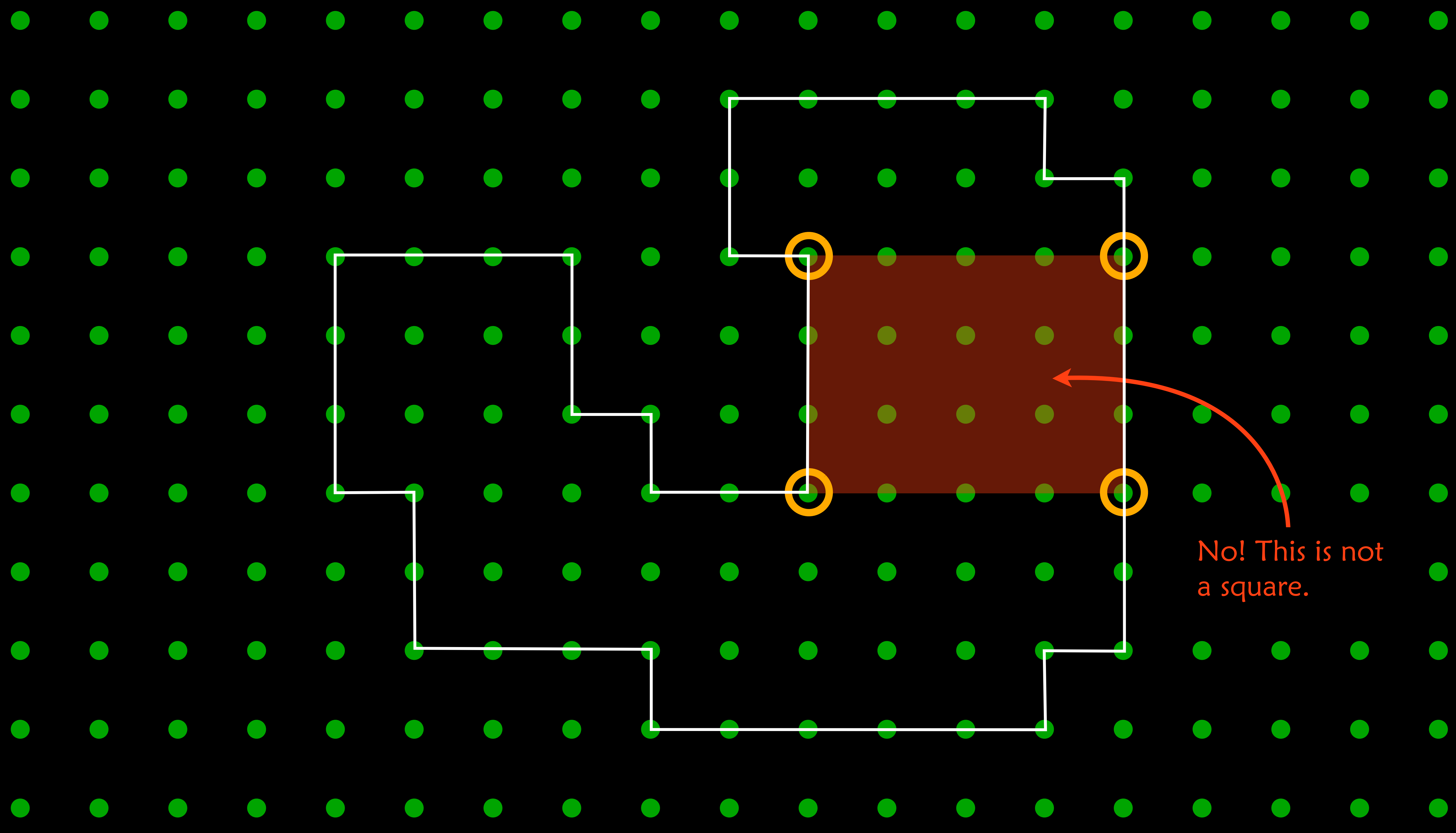

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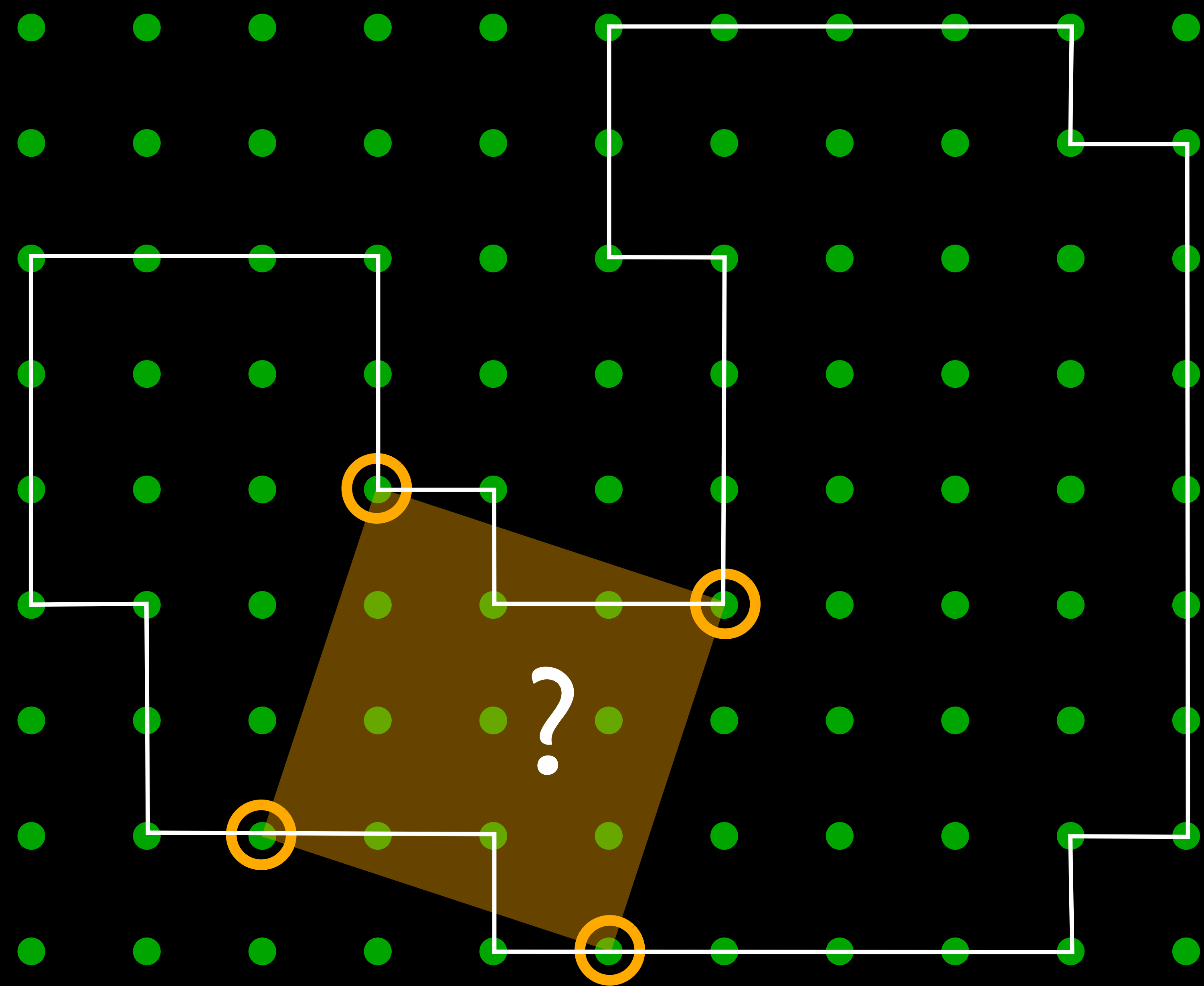

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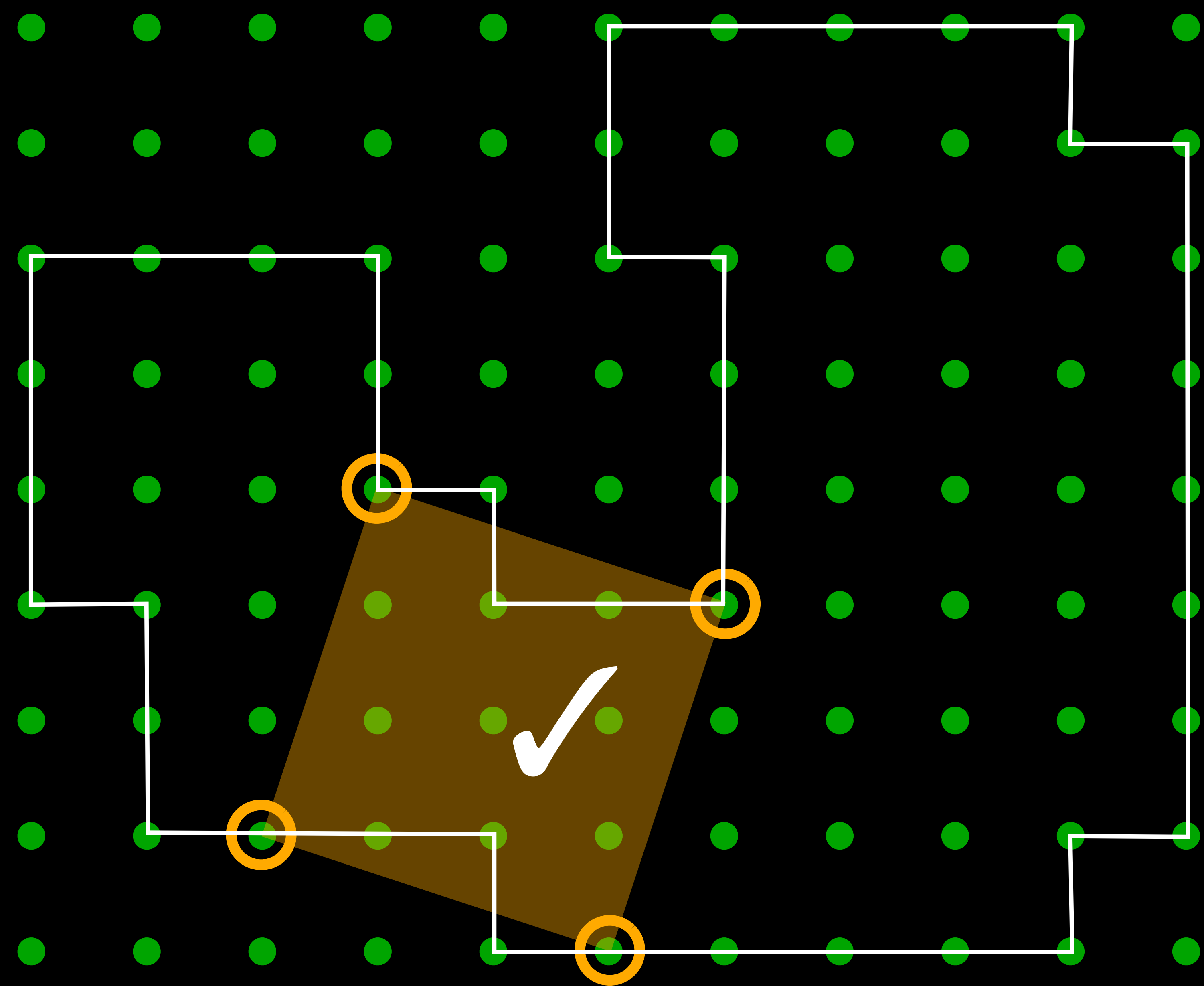

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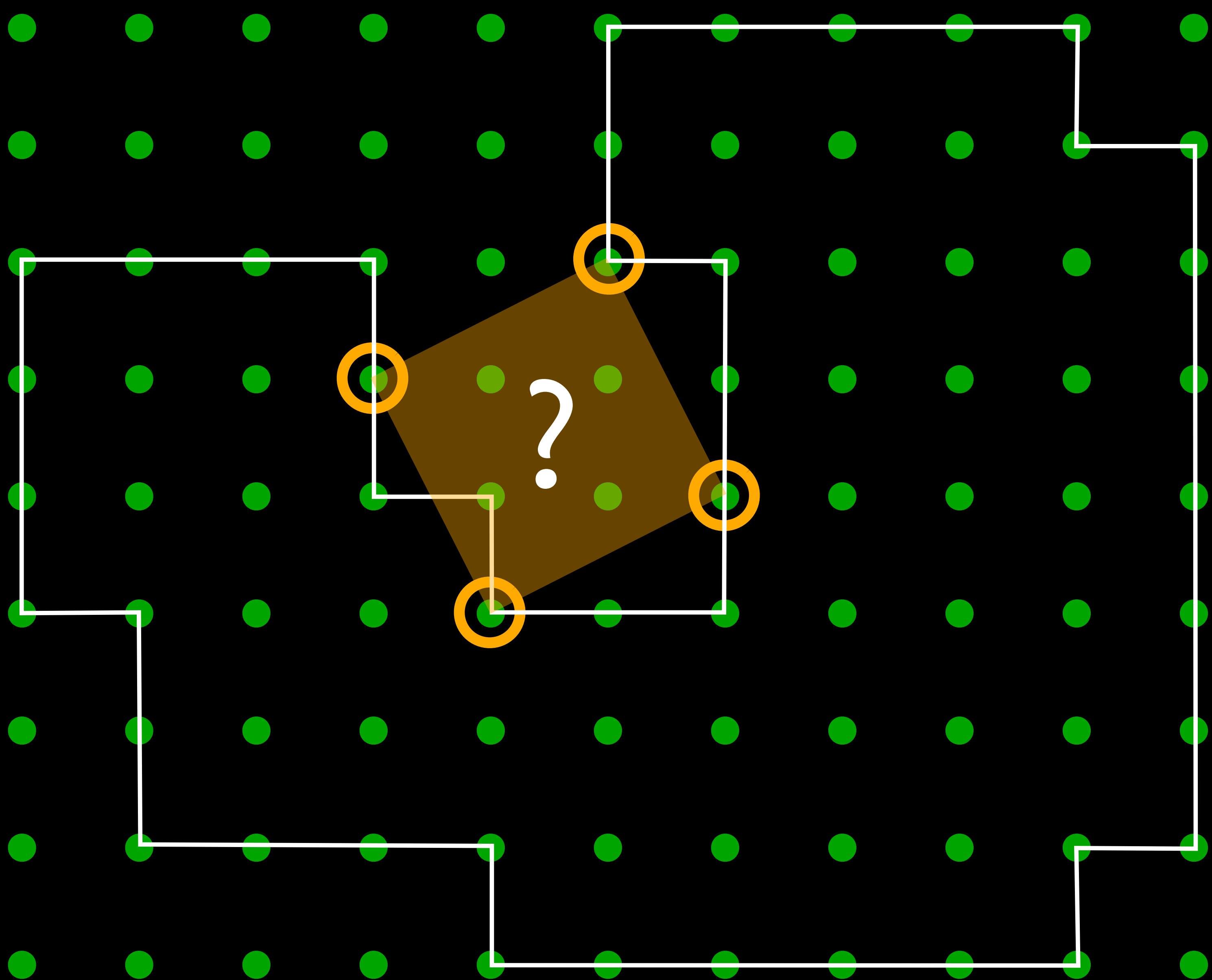

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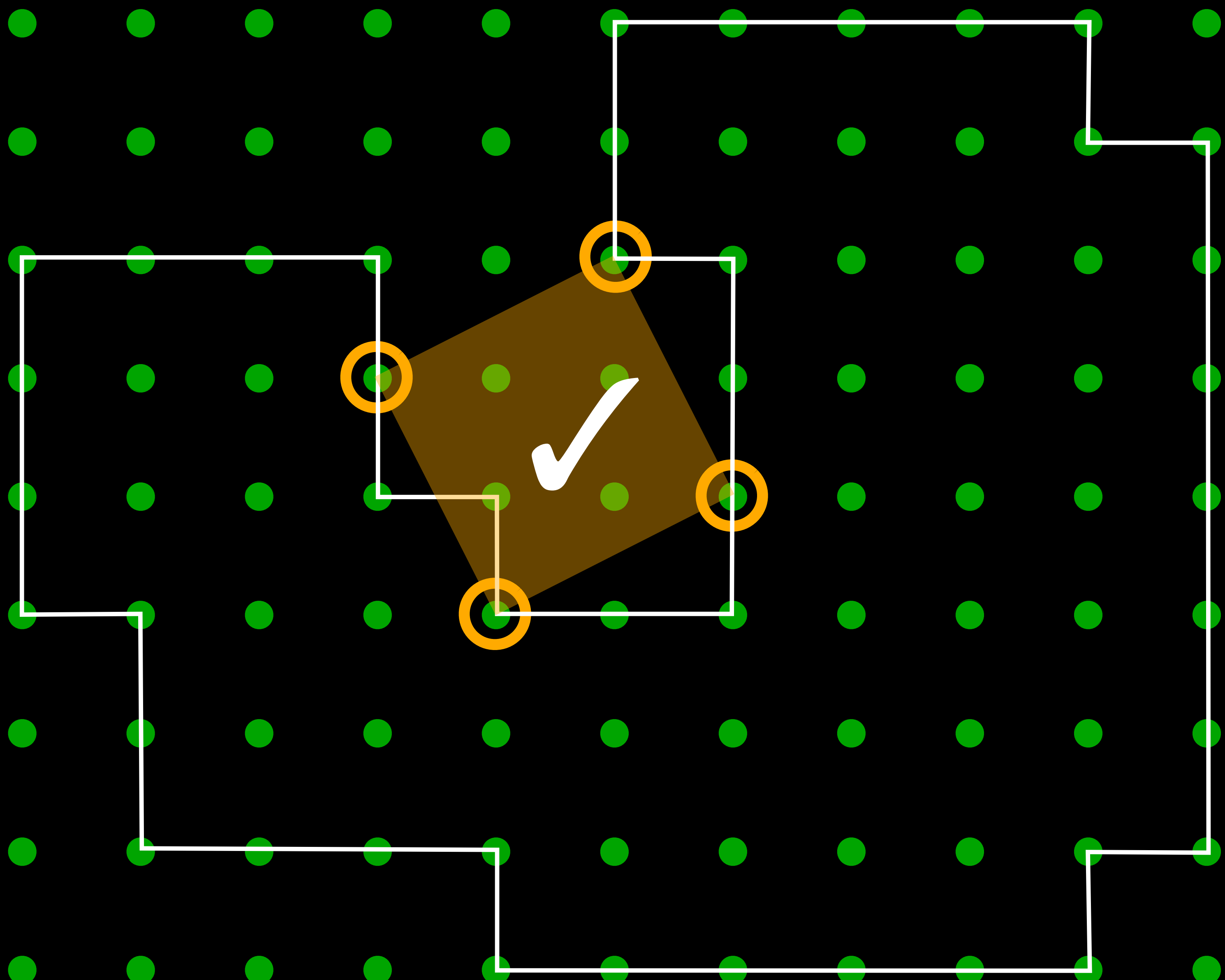

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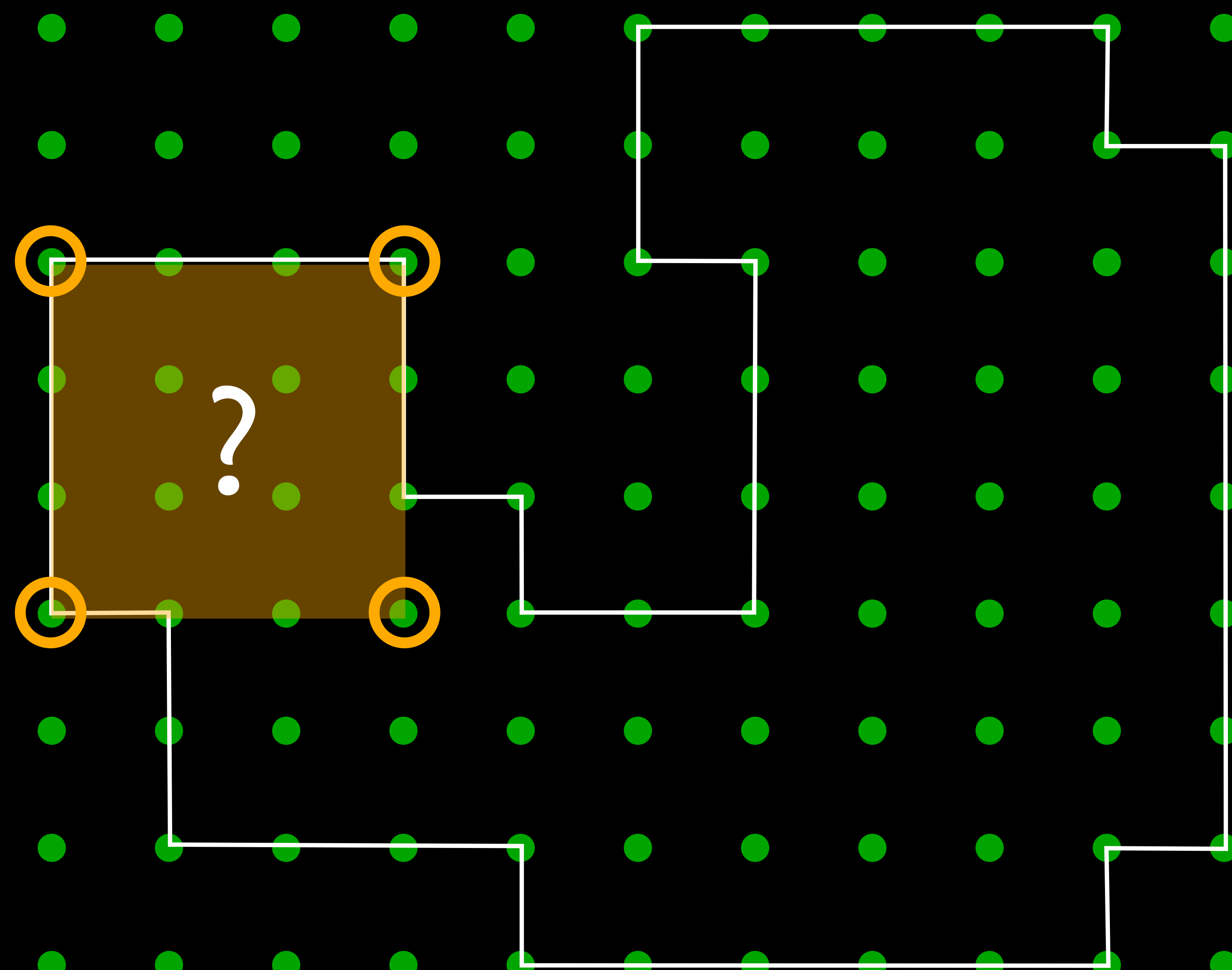

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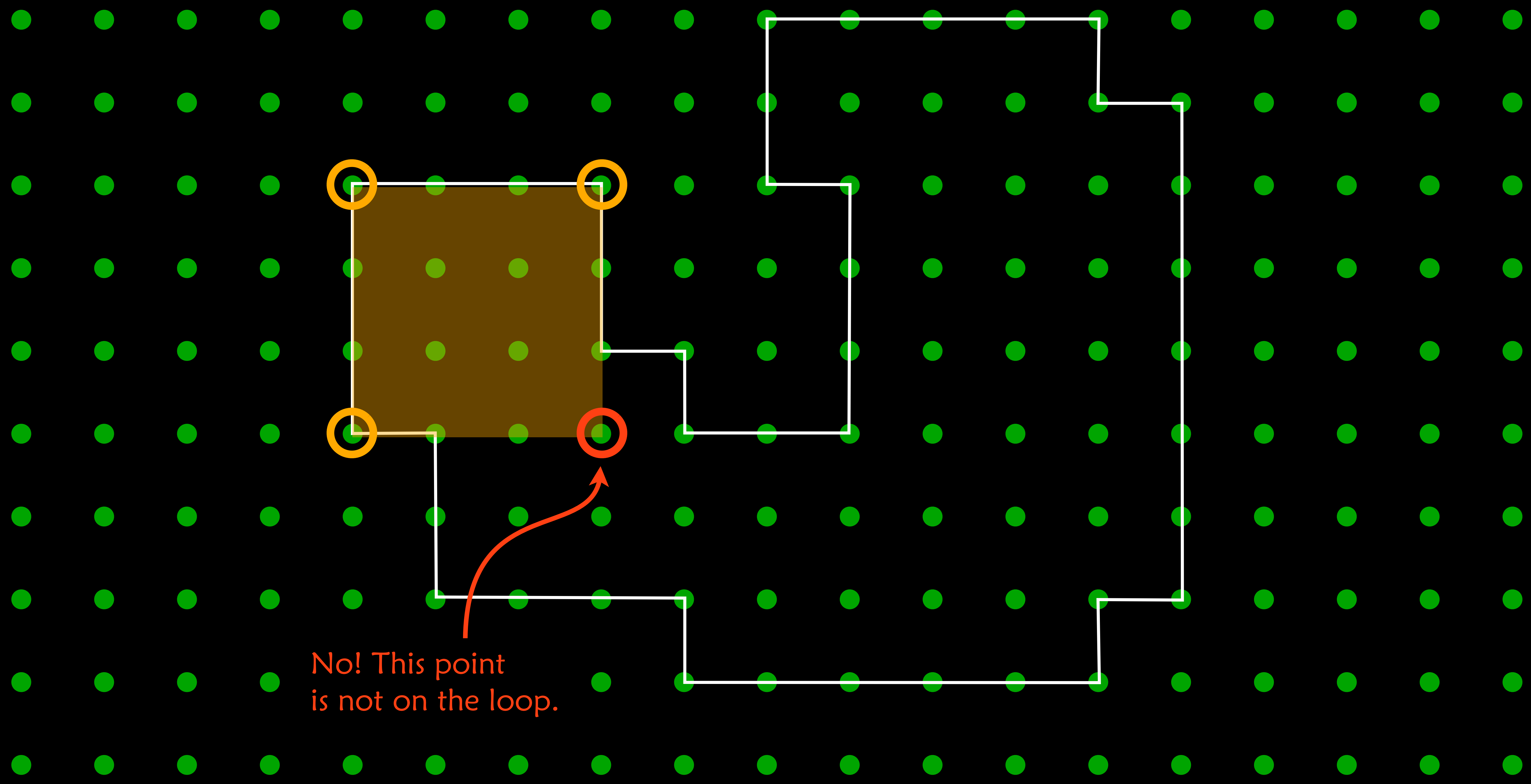

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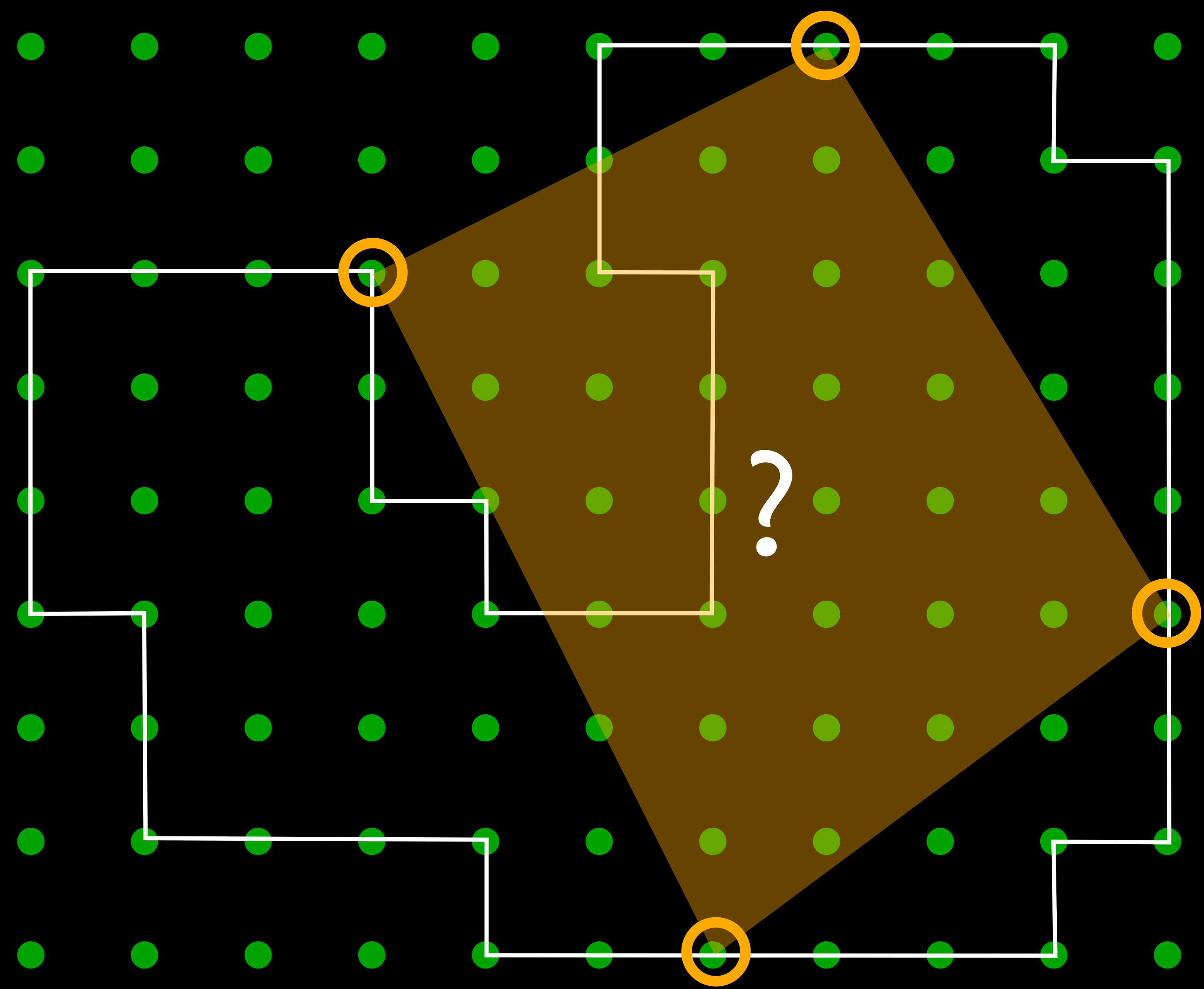

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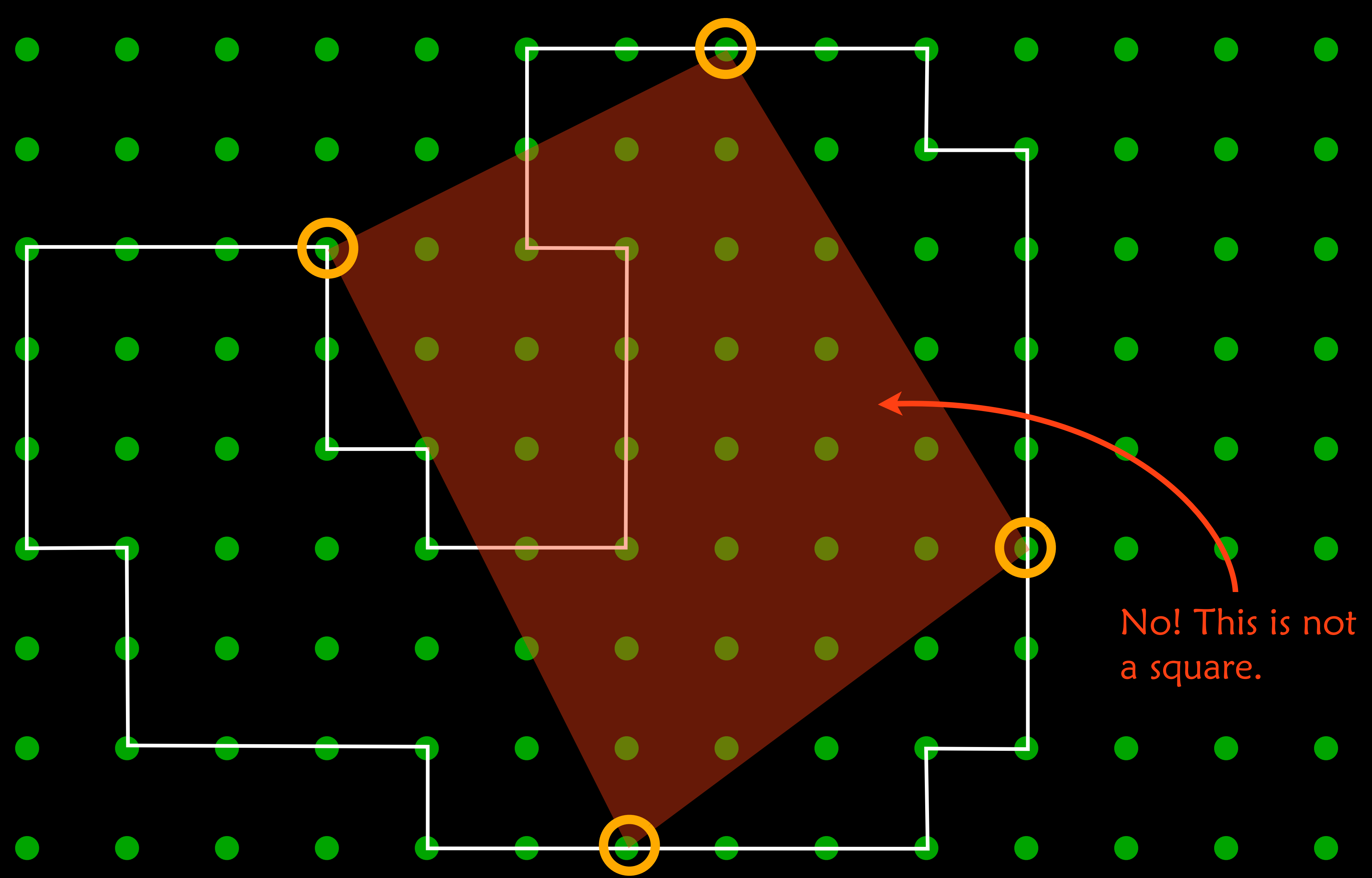

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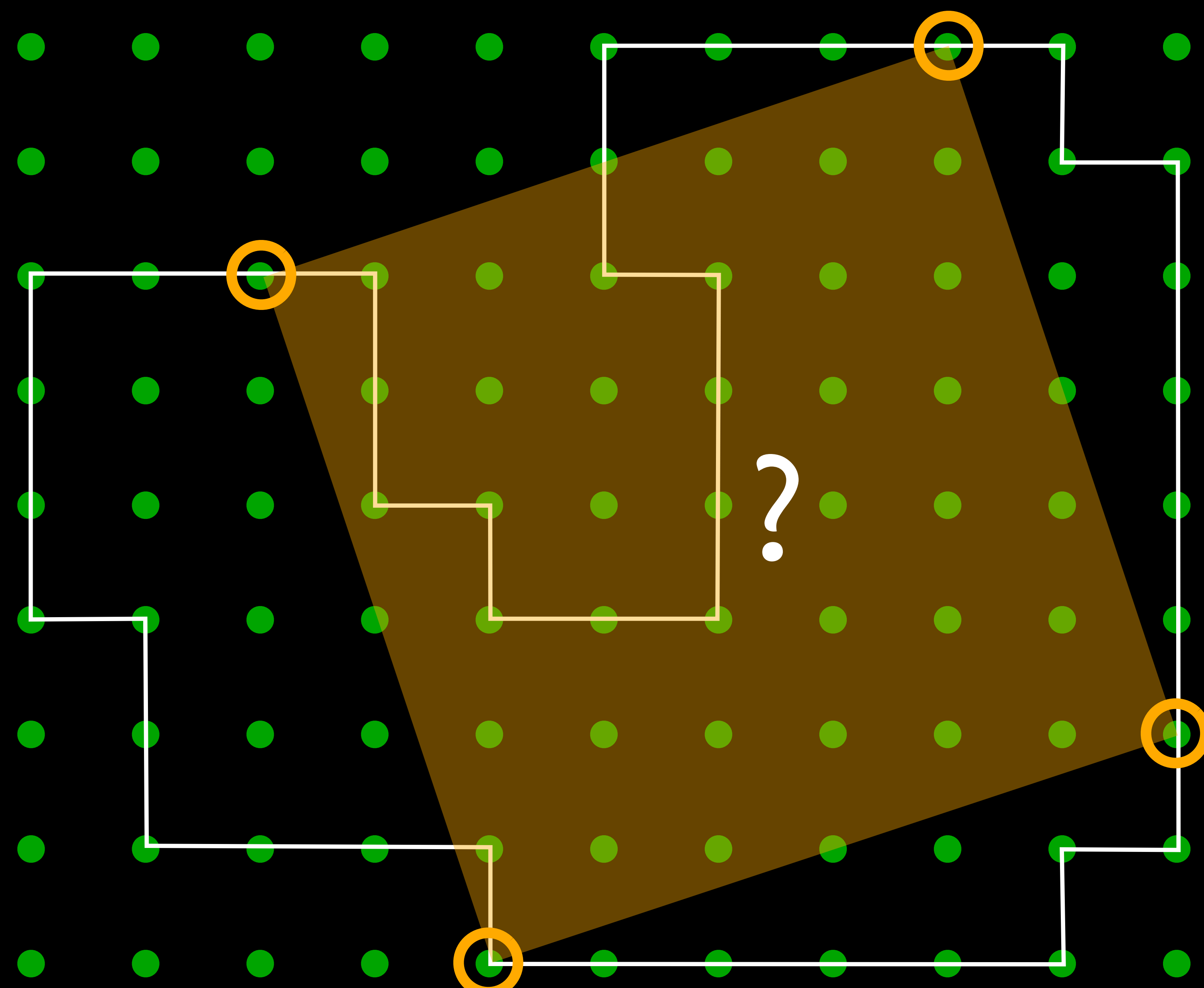

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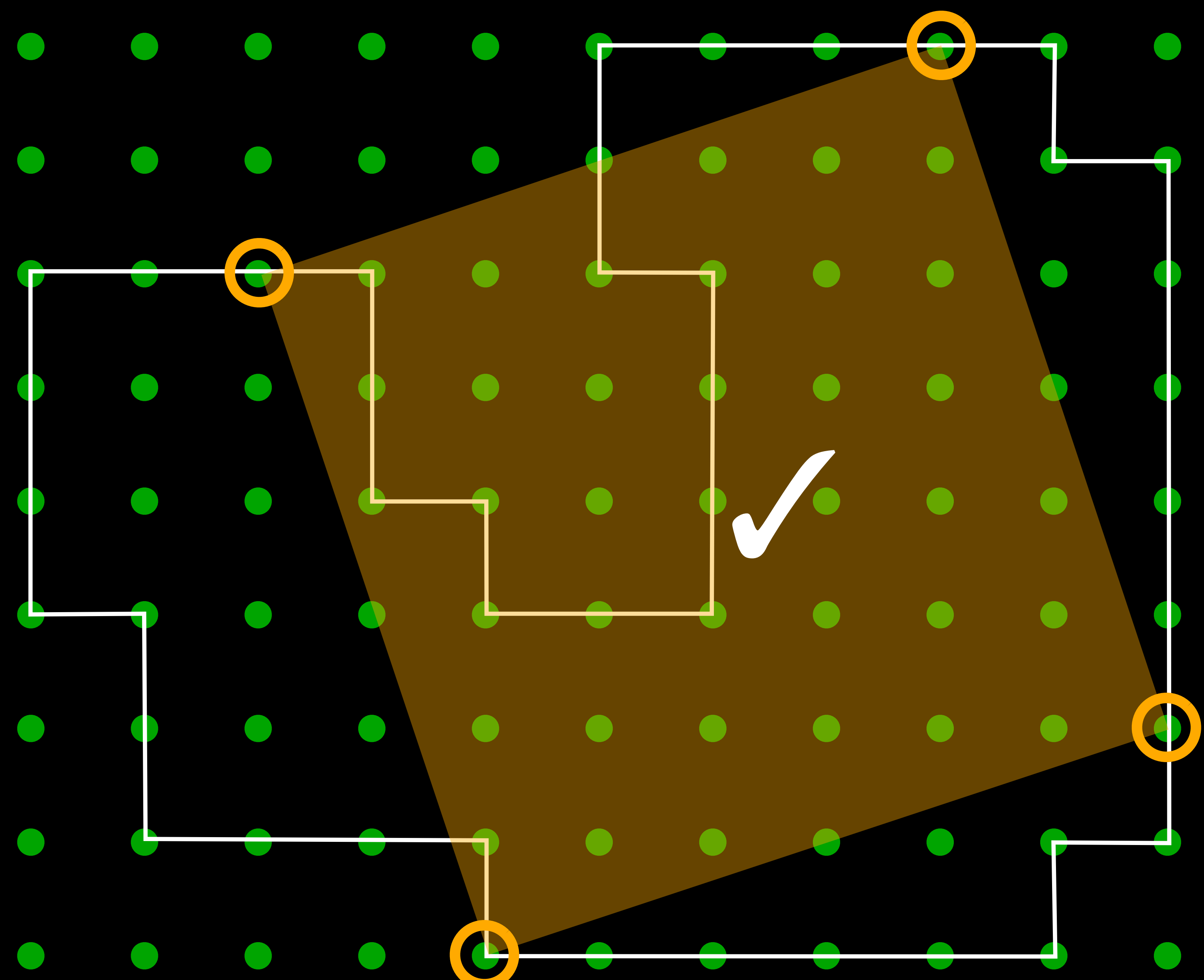

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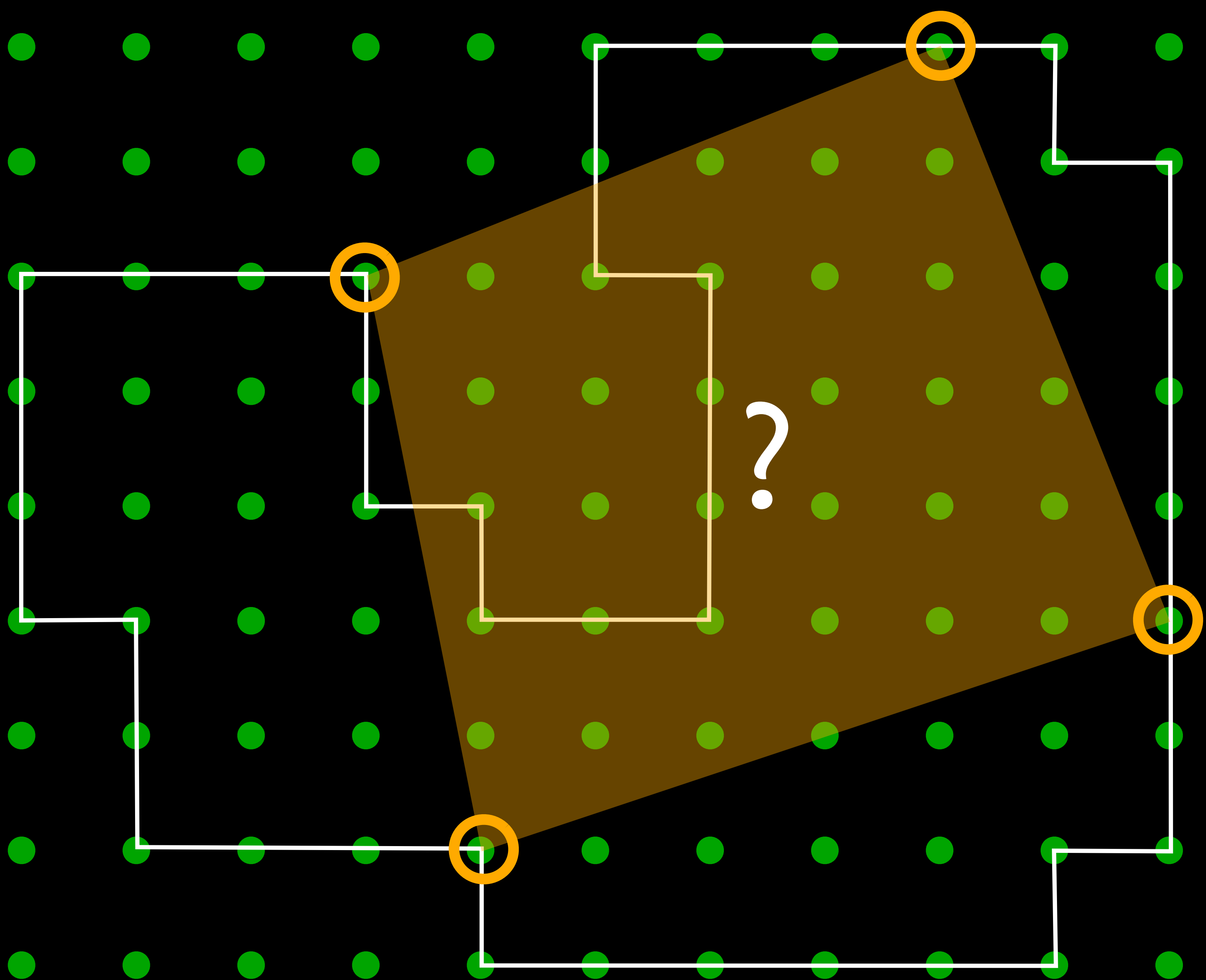

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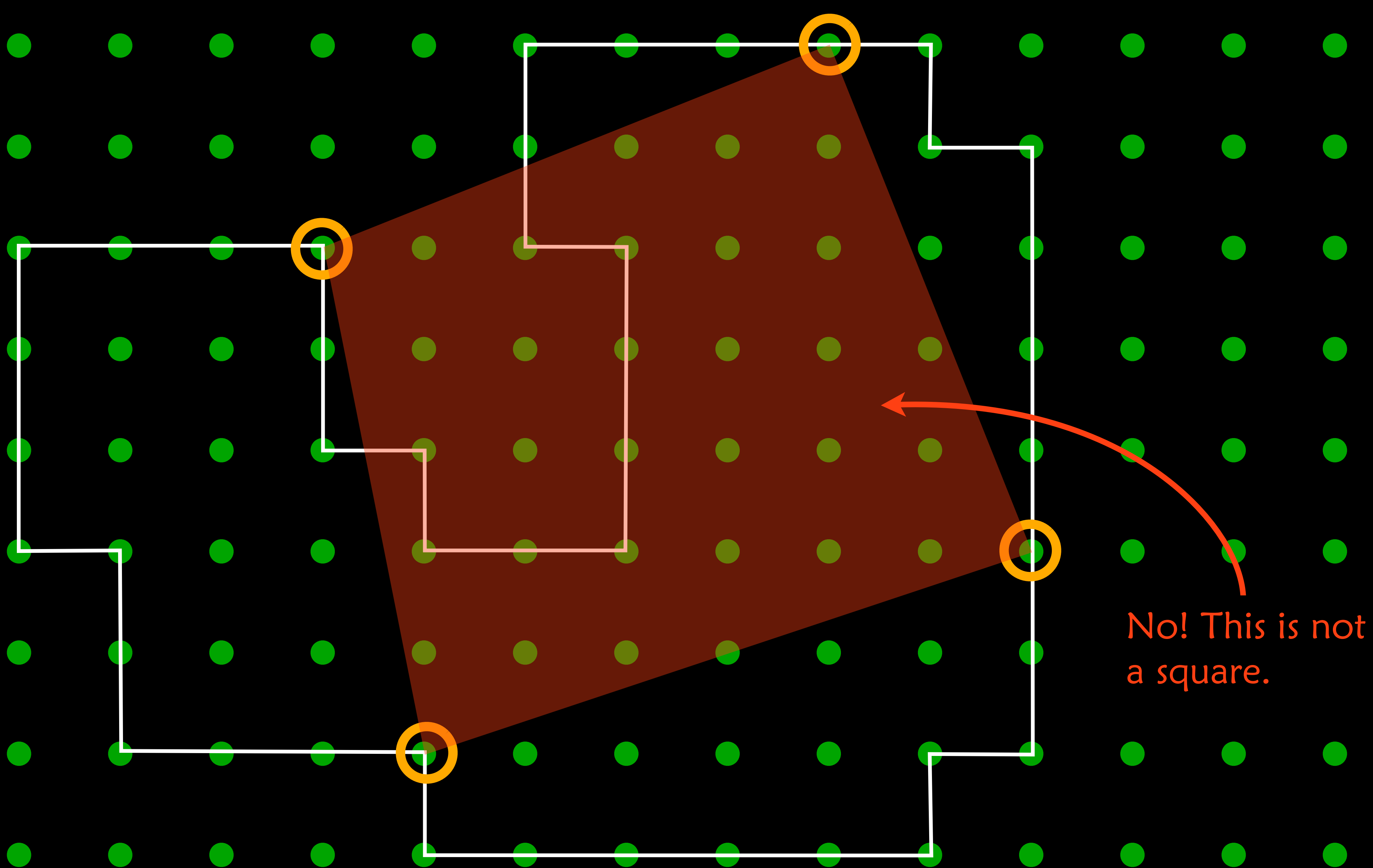
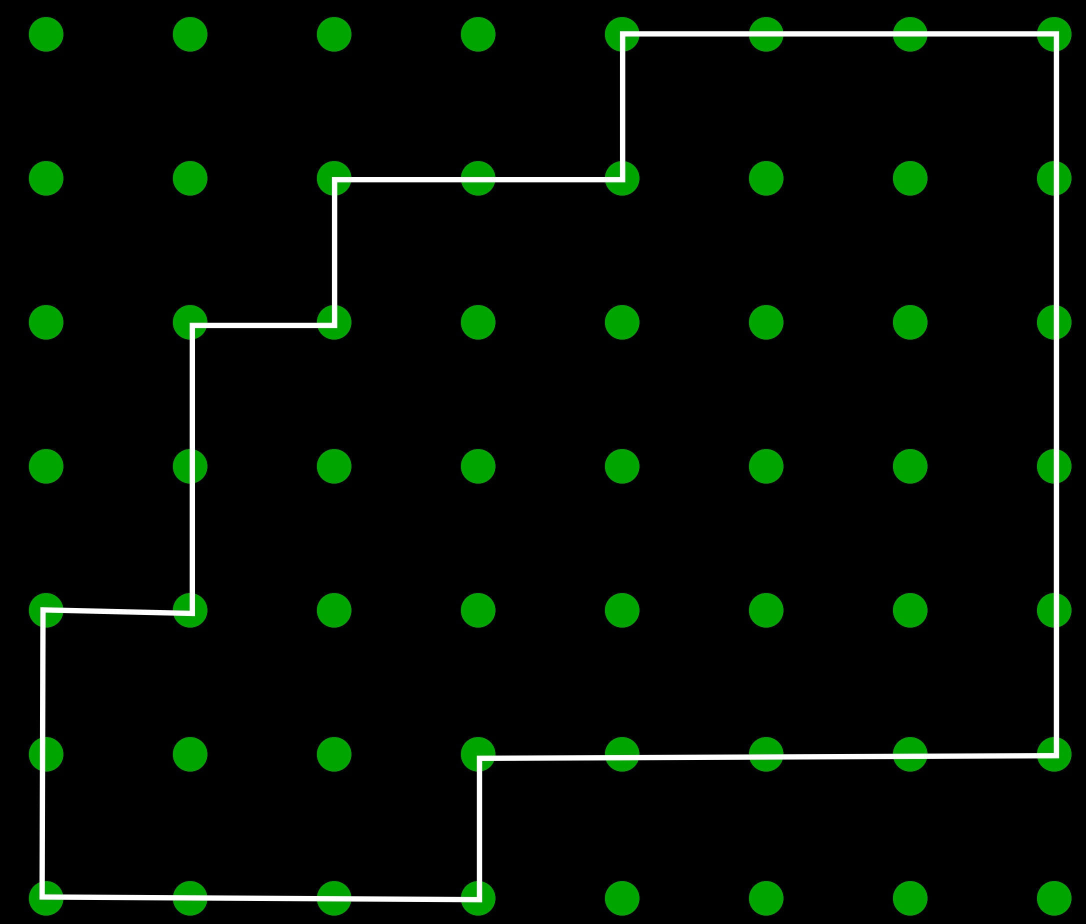


$500 Challenge

No matter what loop the taxi takes, is it always possible to avoid an eternal loopy dream?



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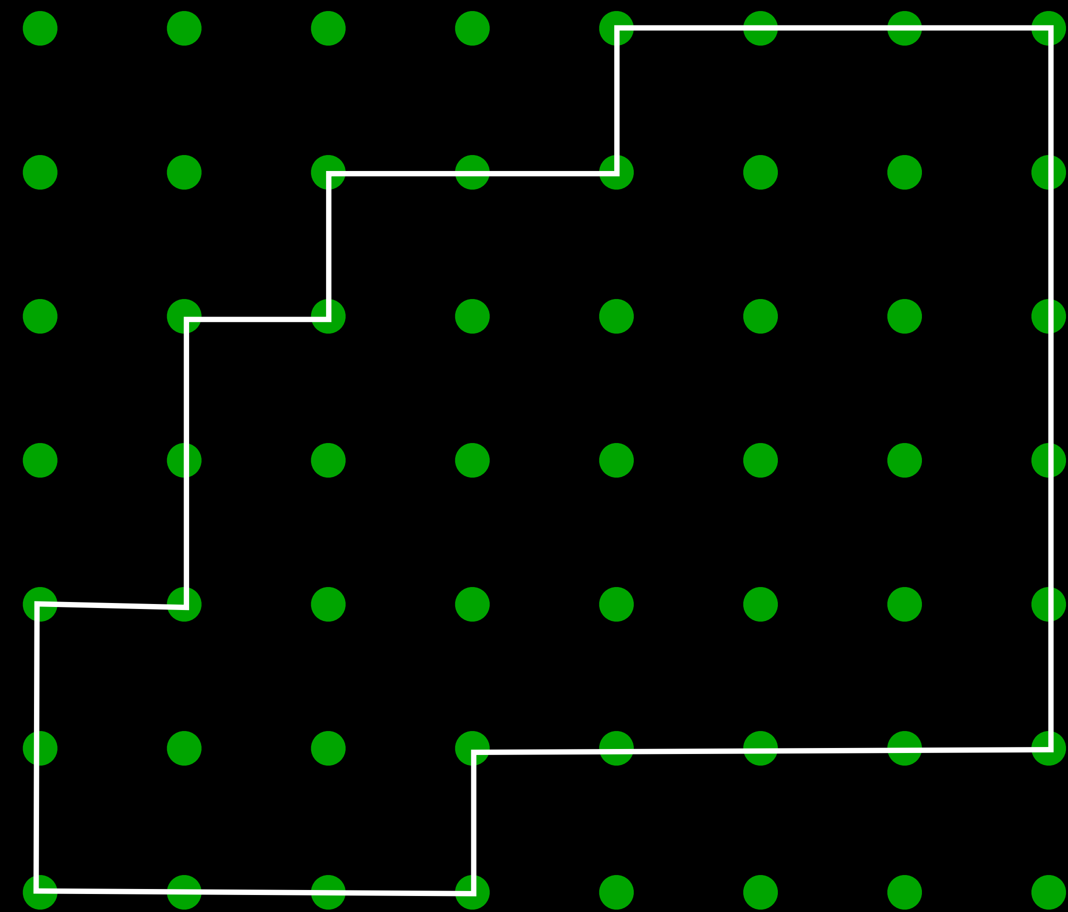

There are four squares here here... Can you find two?

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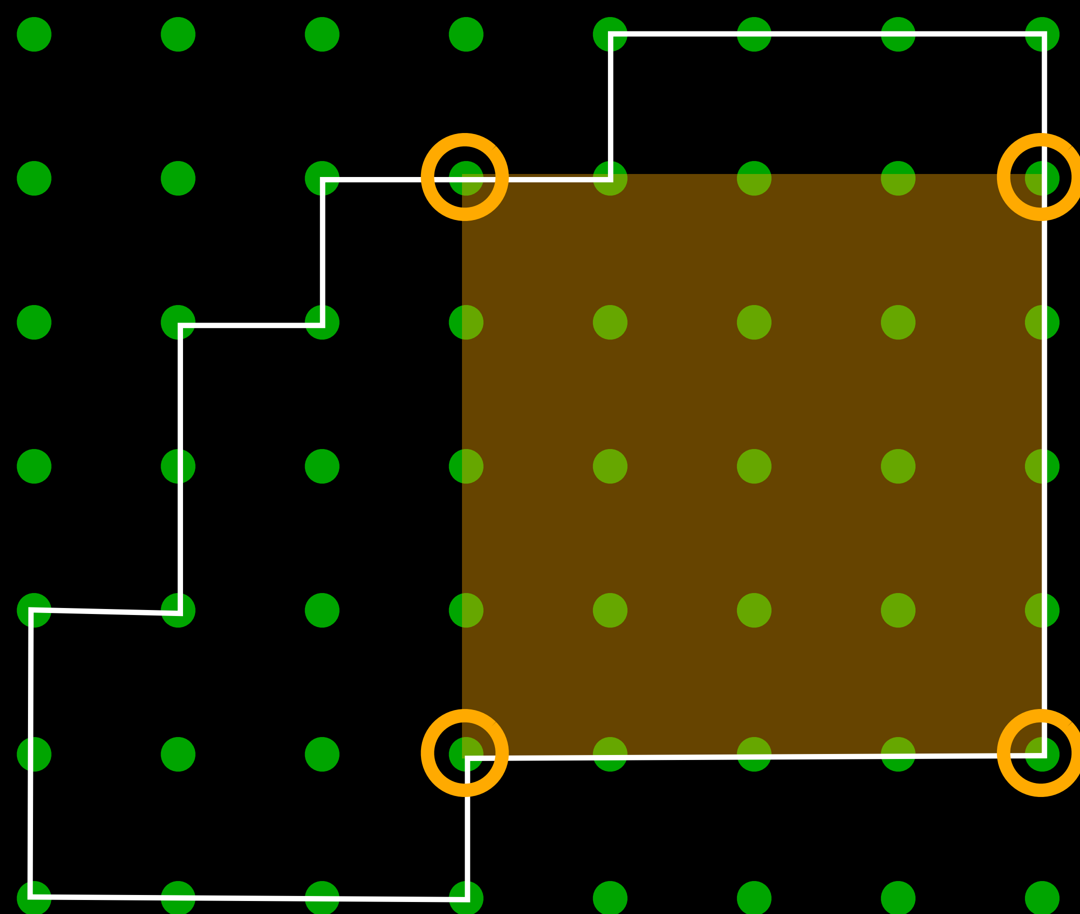

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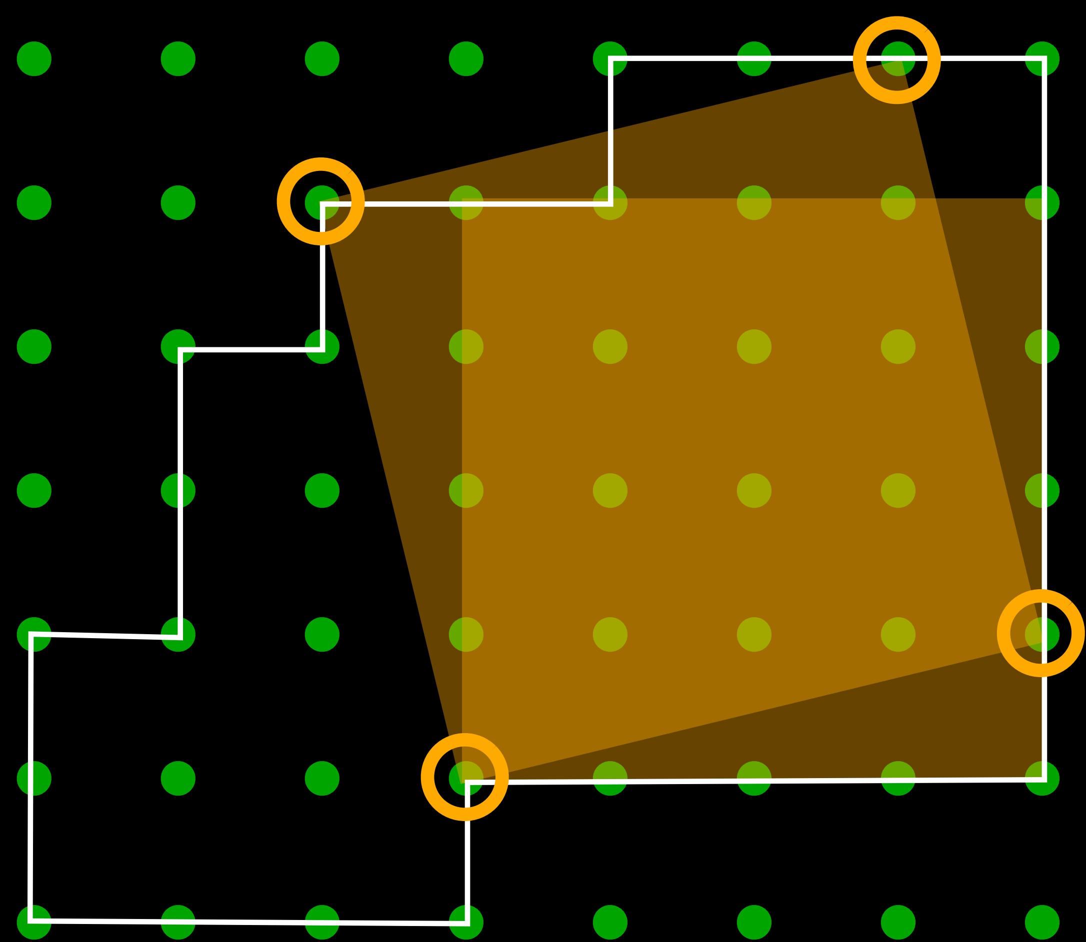

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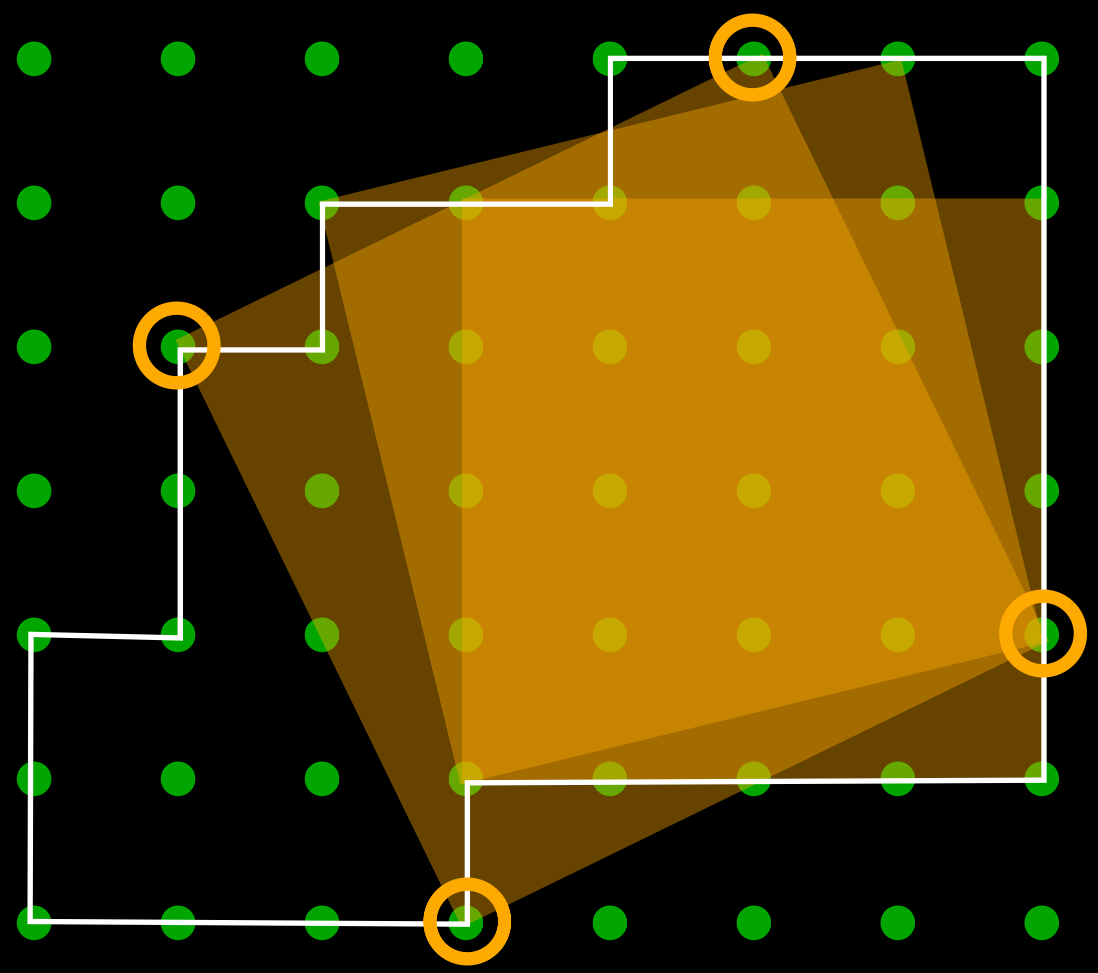

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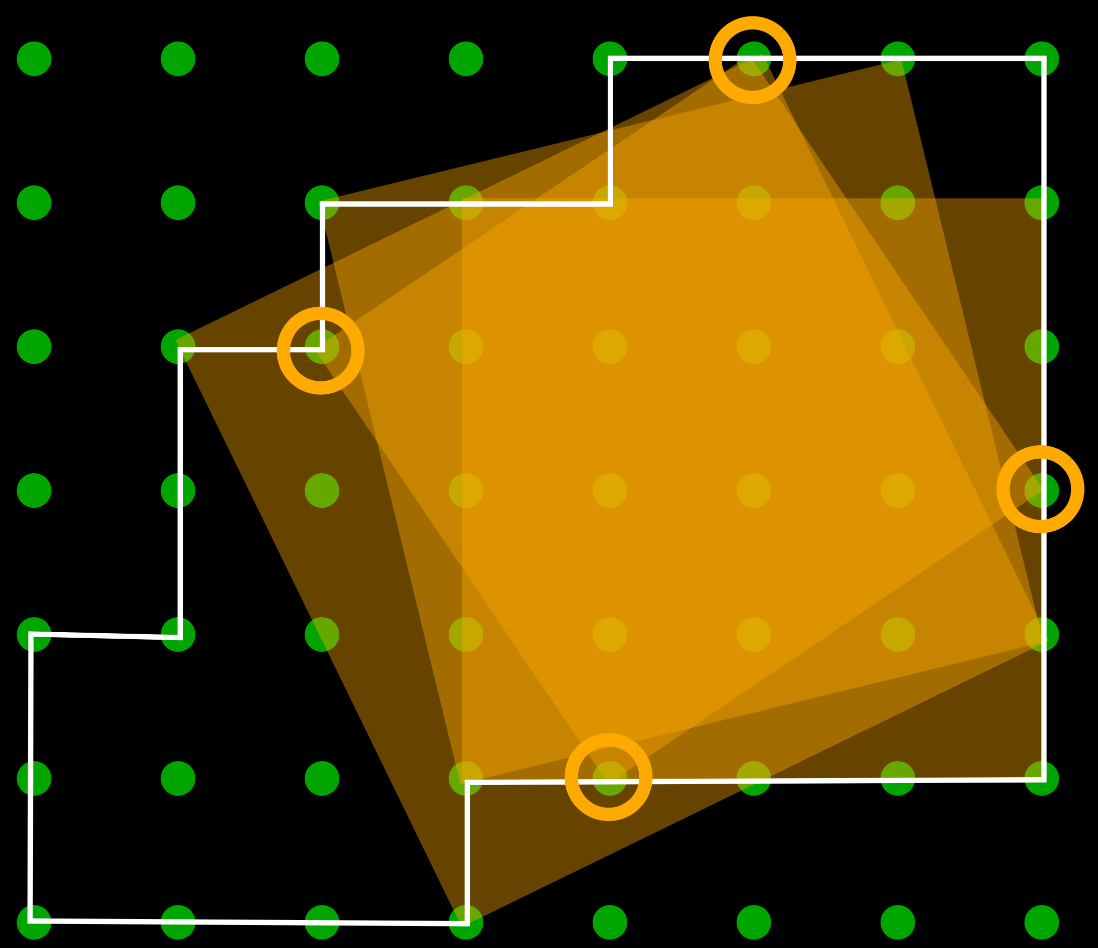
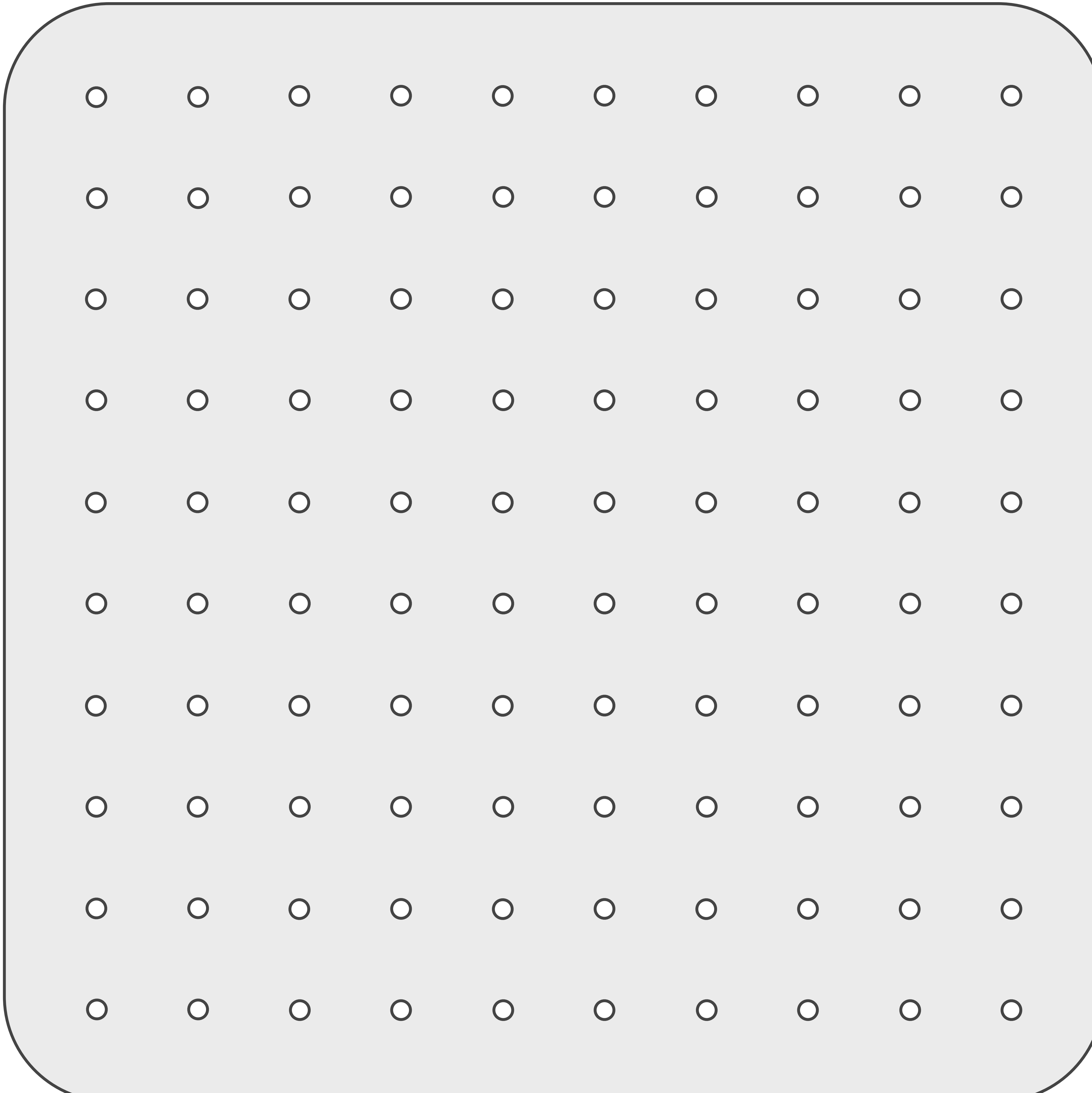
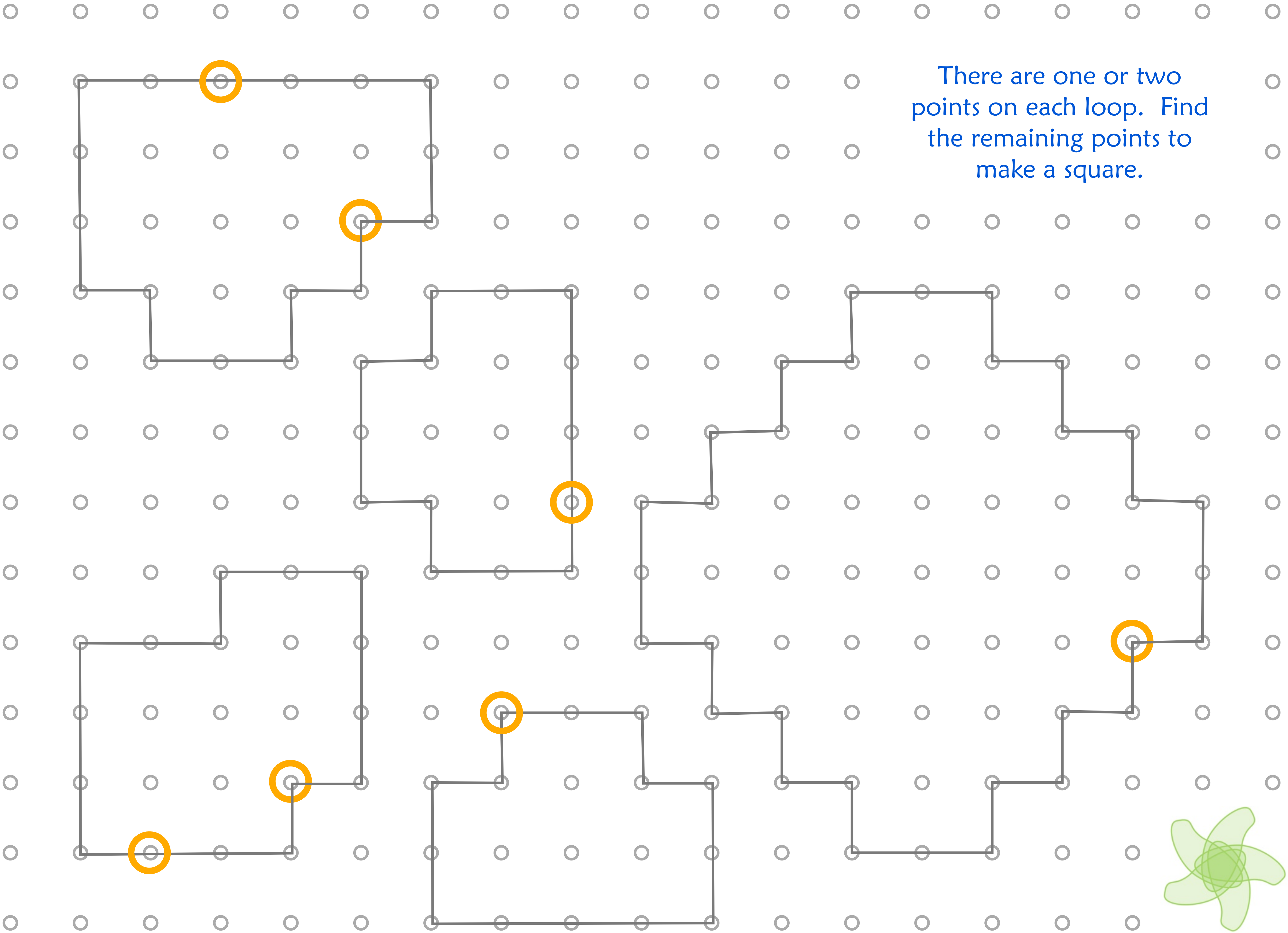


Taxi Cab Squares

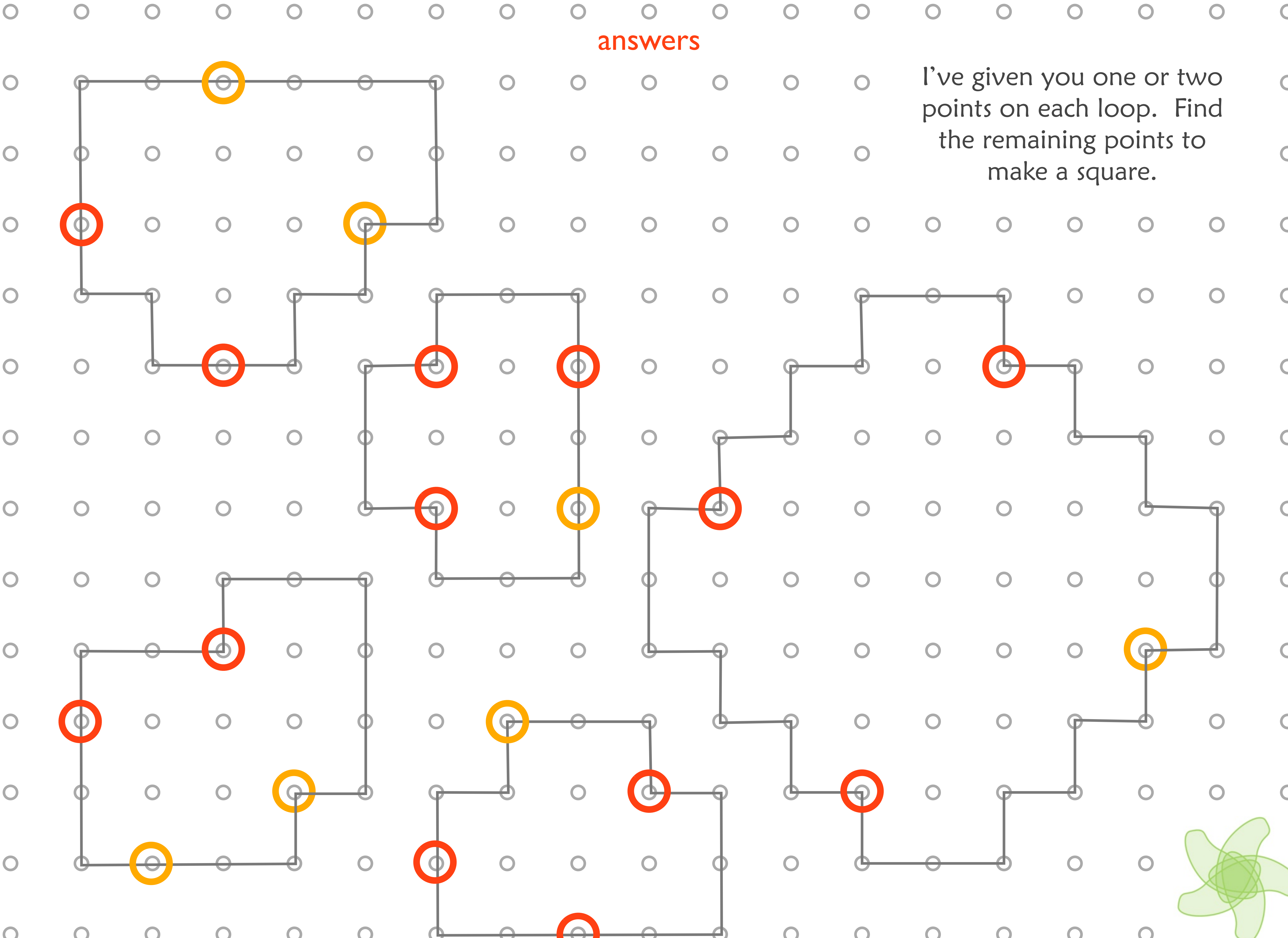


There are one or two points on each loop. Find the remaining points to make a square.

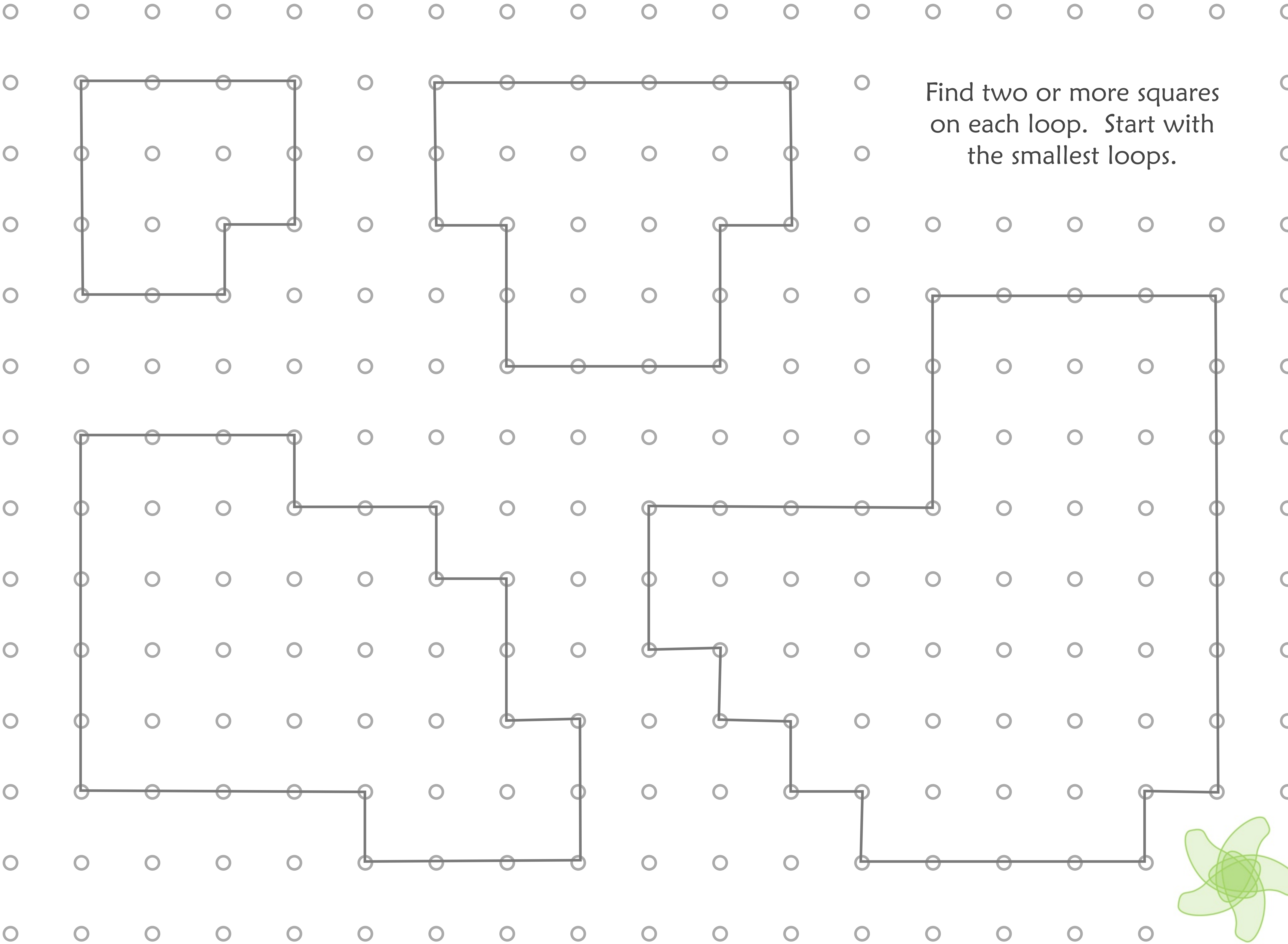


answers

I've given you one or two points on each loop. Find the remaining points to make a square.

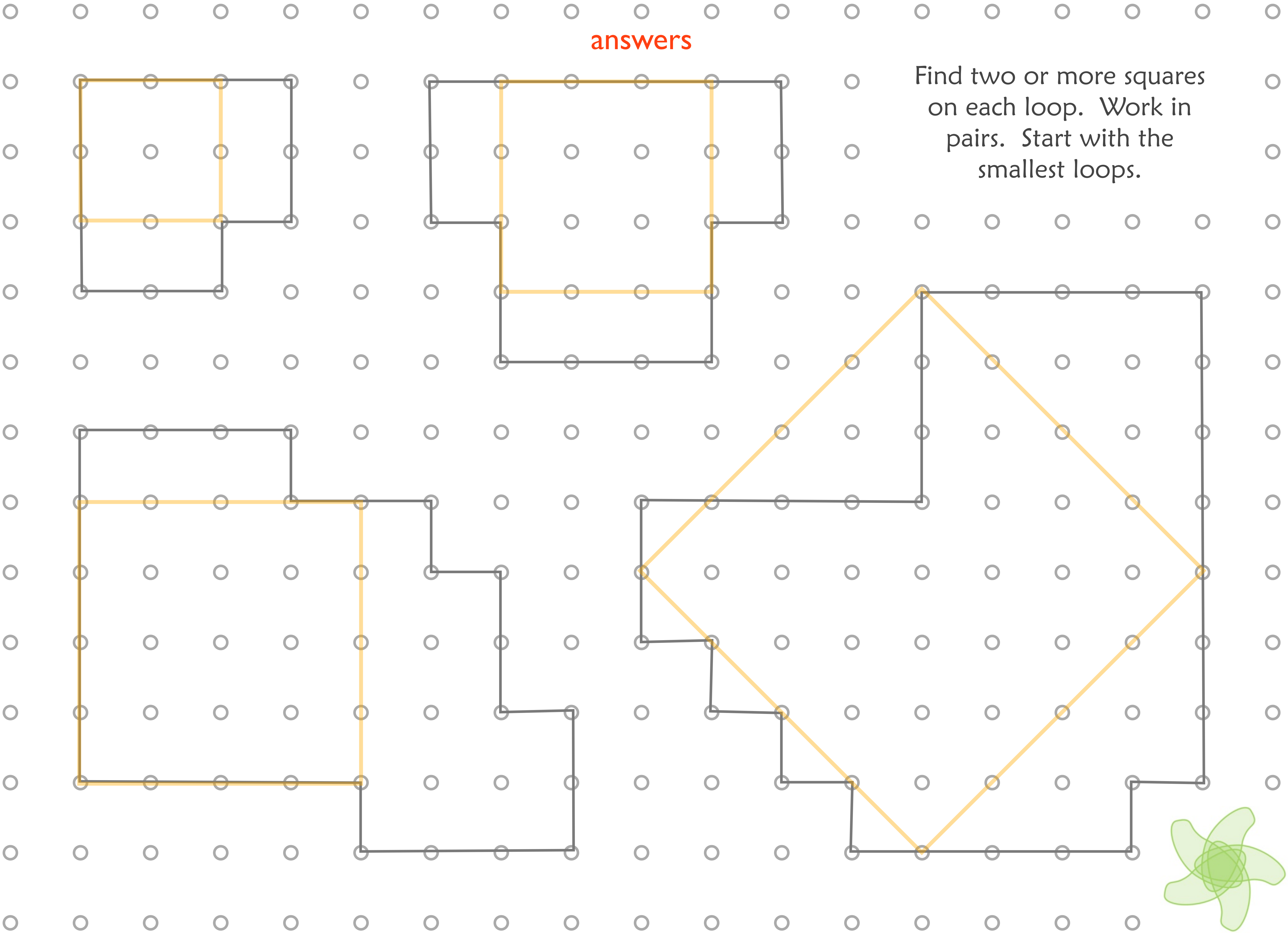


Find two or more squares on each loop. Start with the smallest loops.



answers

Find two or more squares on each loop. Work in pairs. Start with the smallest loops.



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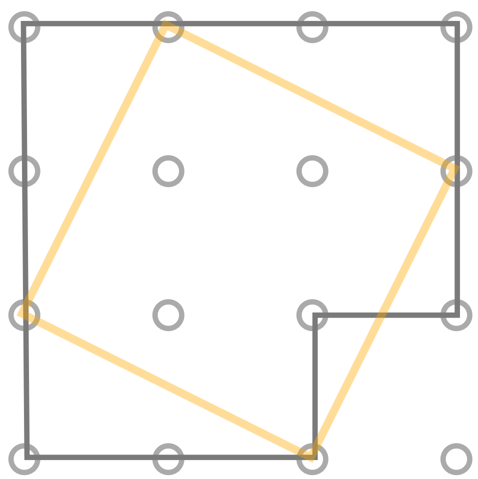

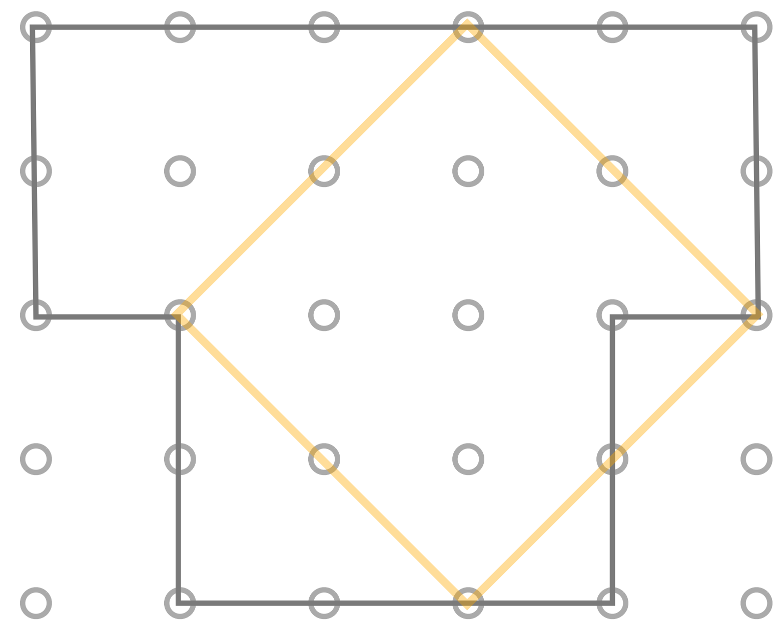

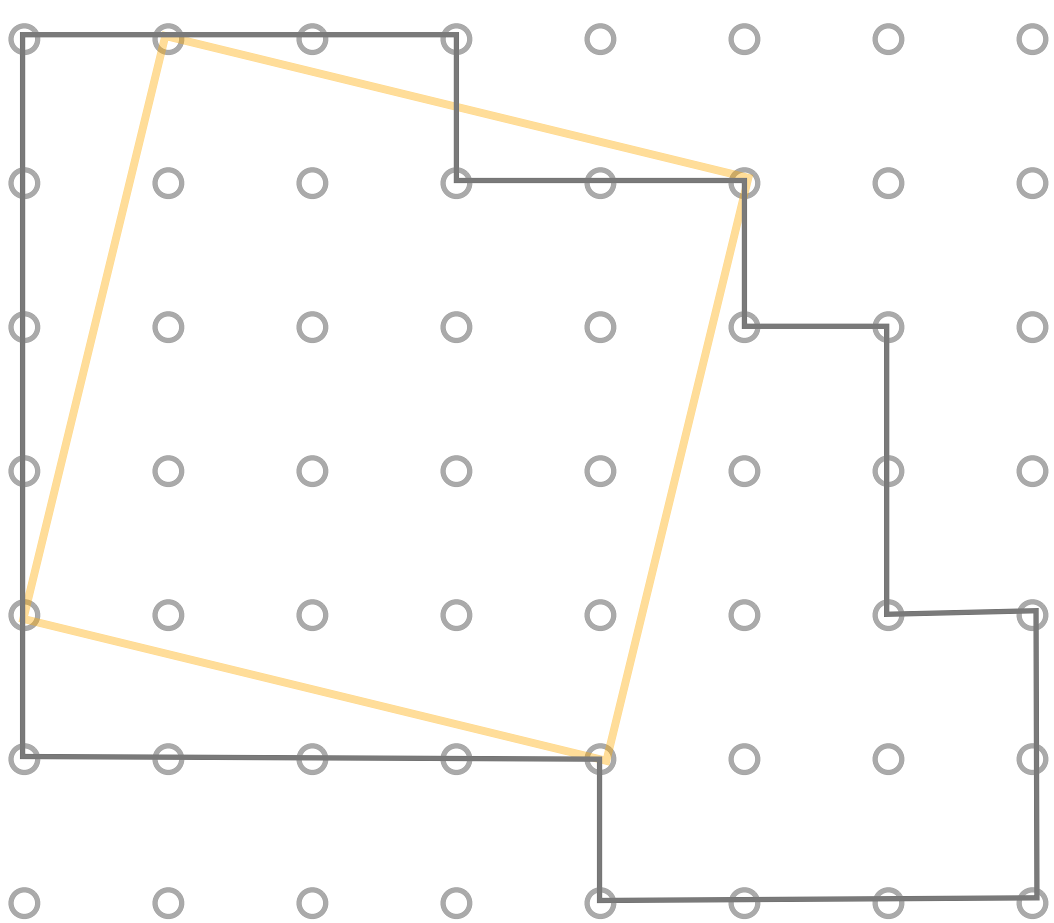

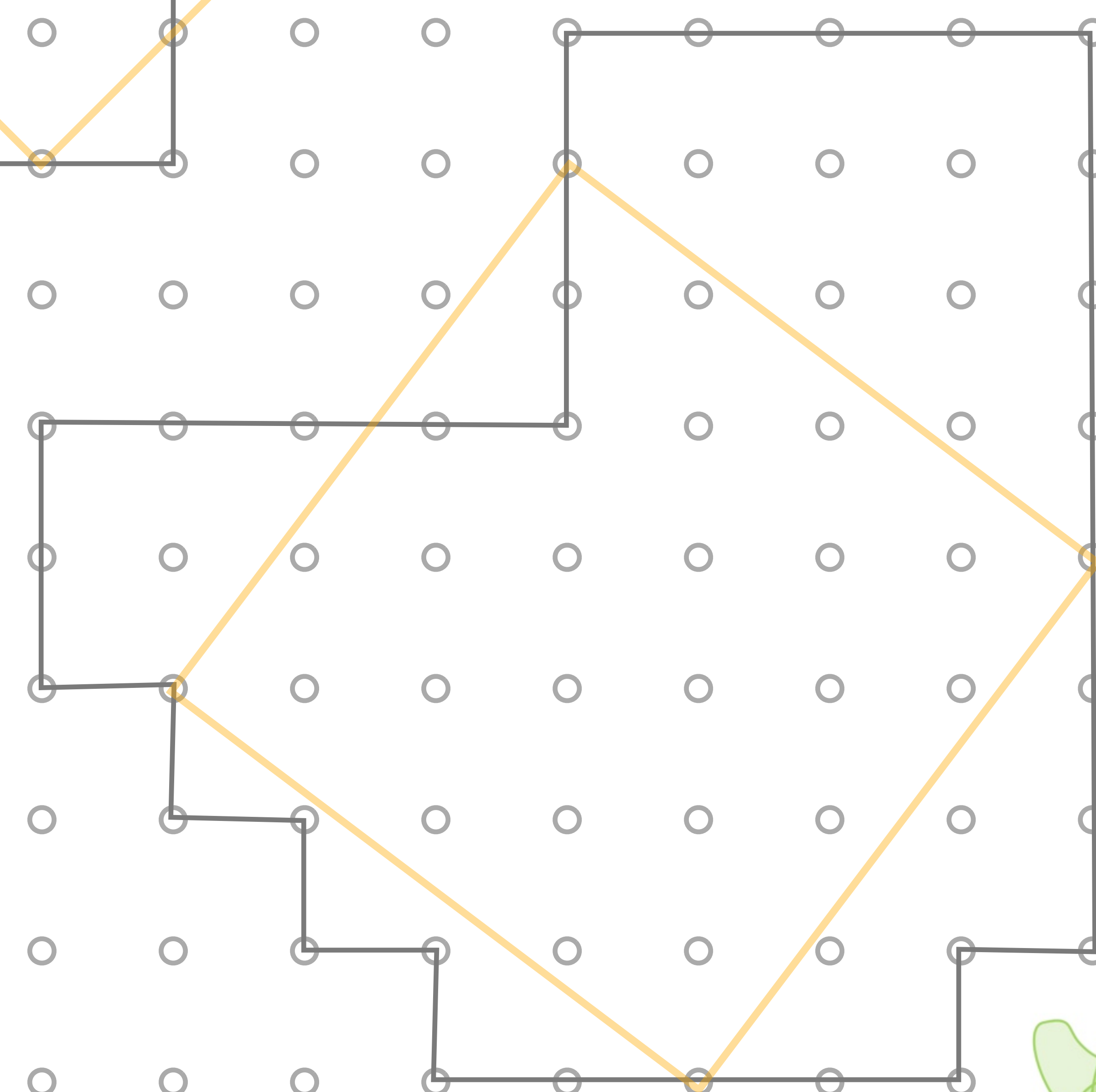

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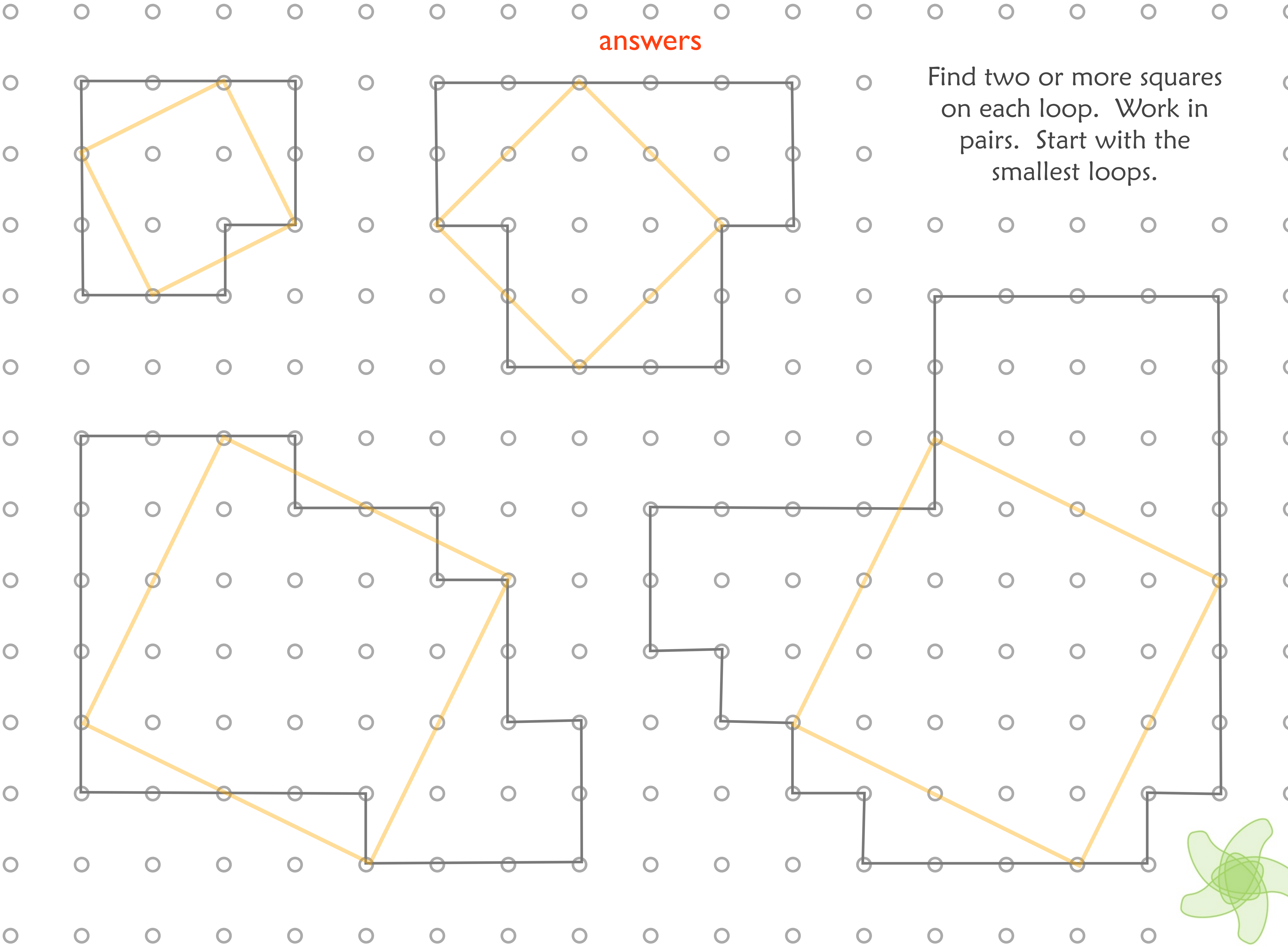

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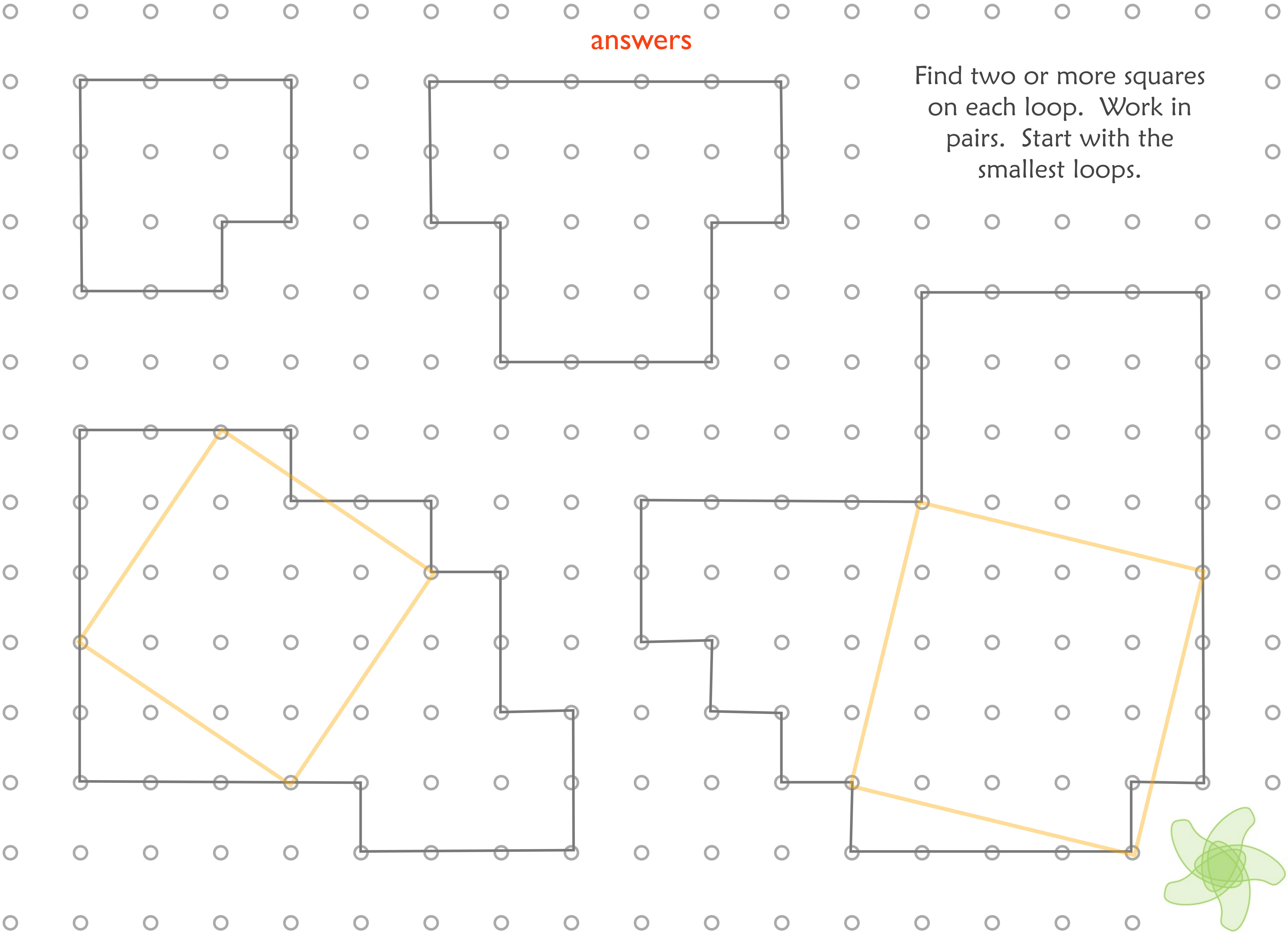
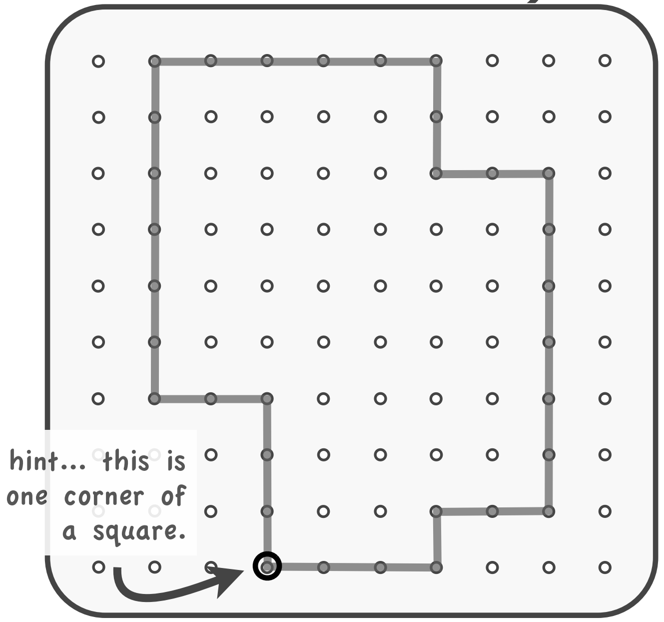


Taxi Cab Squares

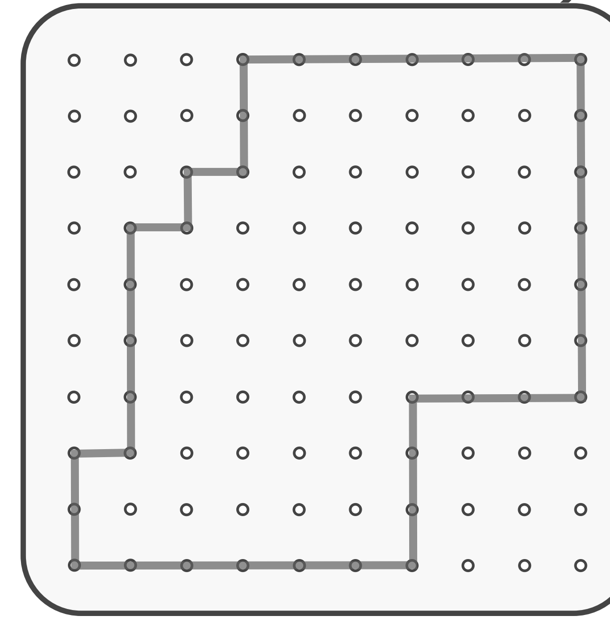
Make a loop for your friend or enemy. They must try to find a square with all 4 corners on the loop. You win if they can't find such a square in one minute.
Do all loops have such a square?
Are there always at least two such squares on every loop??

Students in one of my schools made the following loops. They all have at least two square solutions.

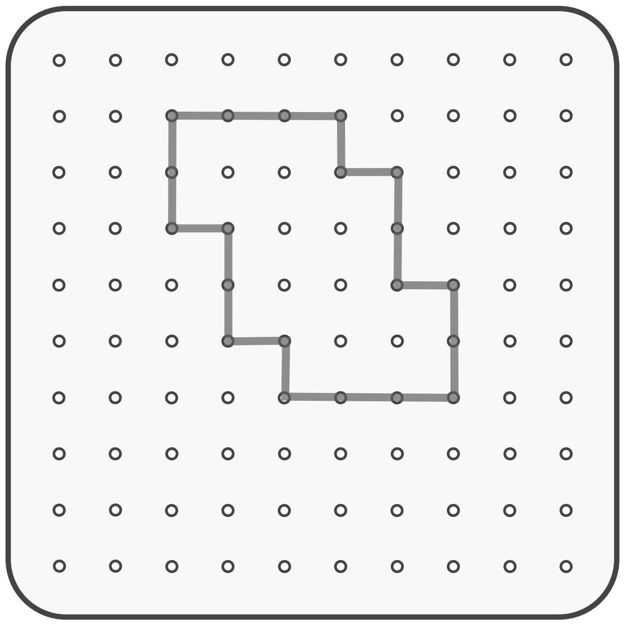
Wayne



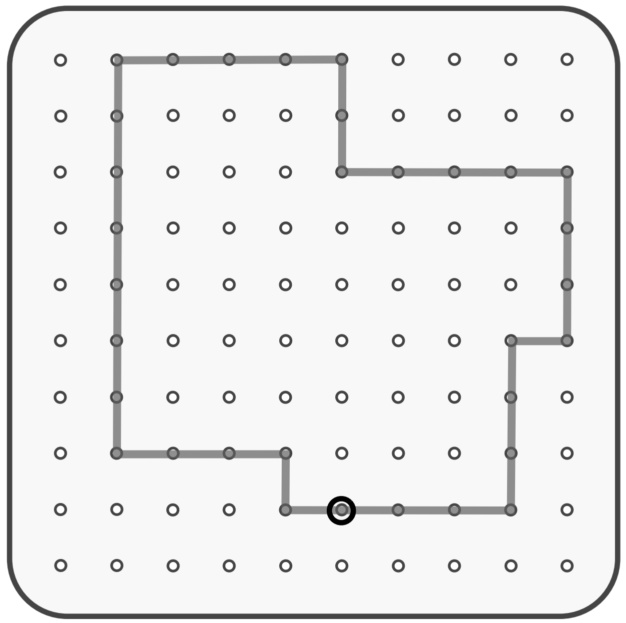
Bailey



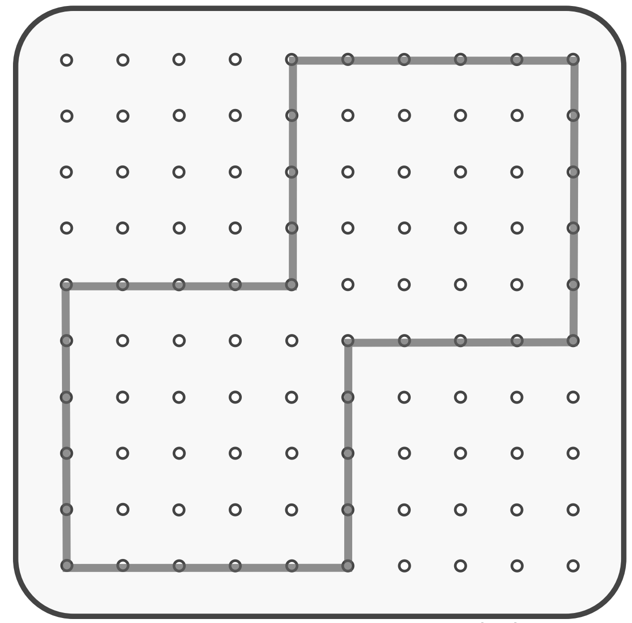
William



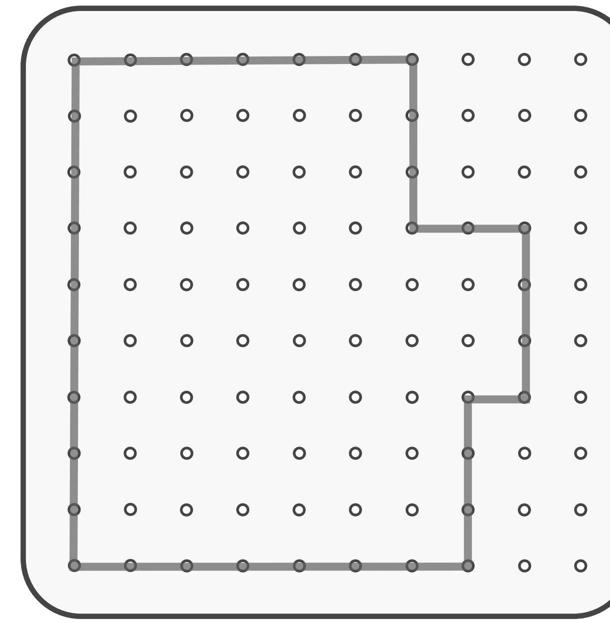
Isabella



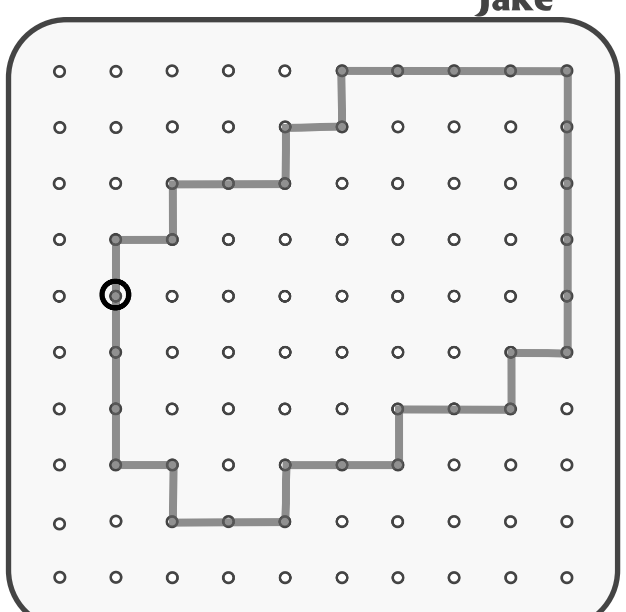
Sasa



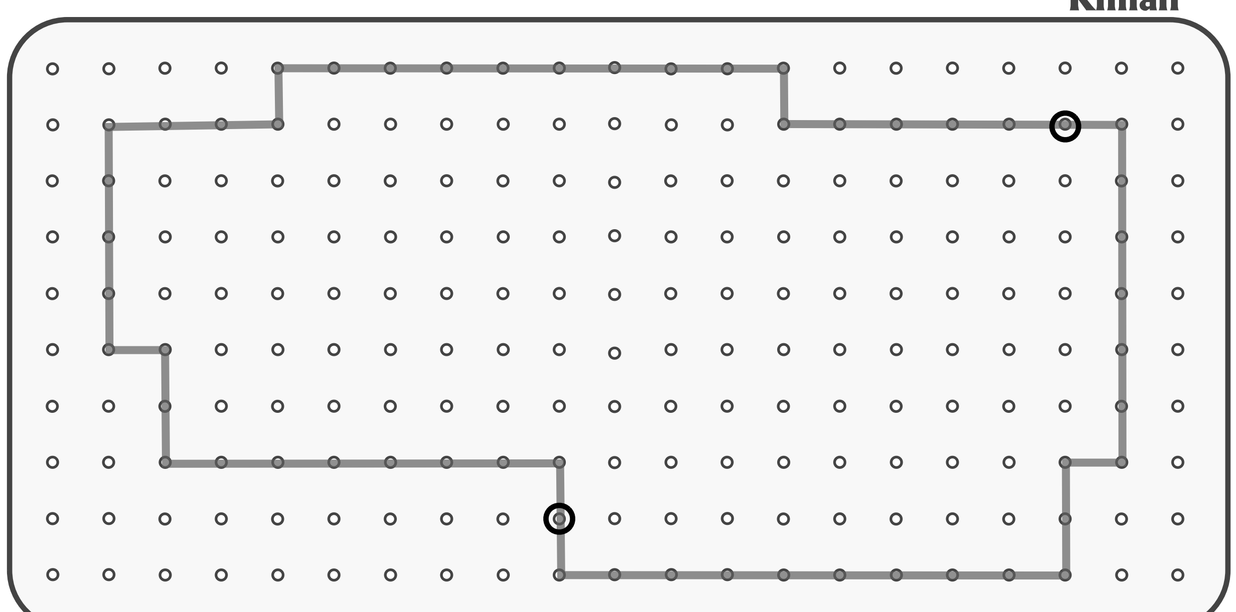
Yousra



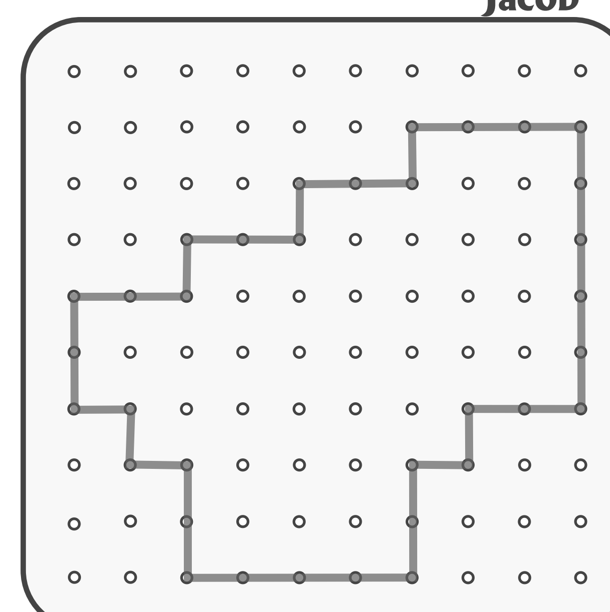
Jake



Killian

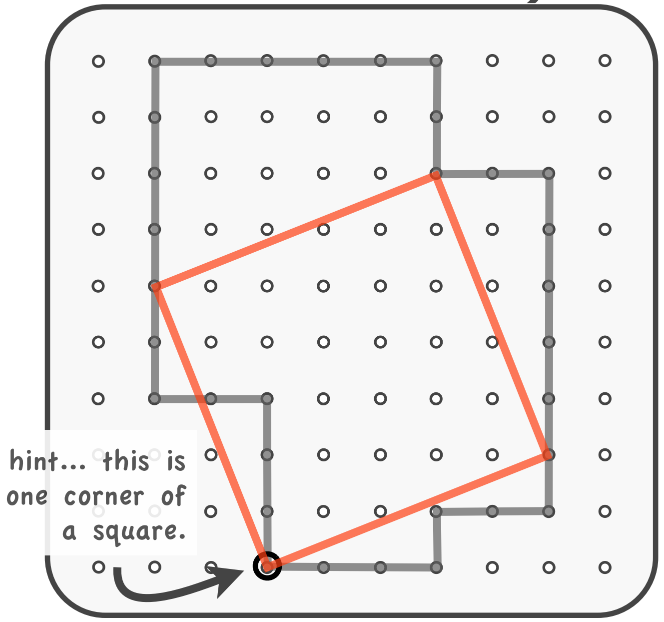


Jacob



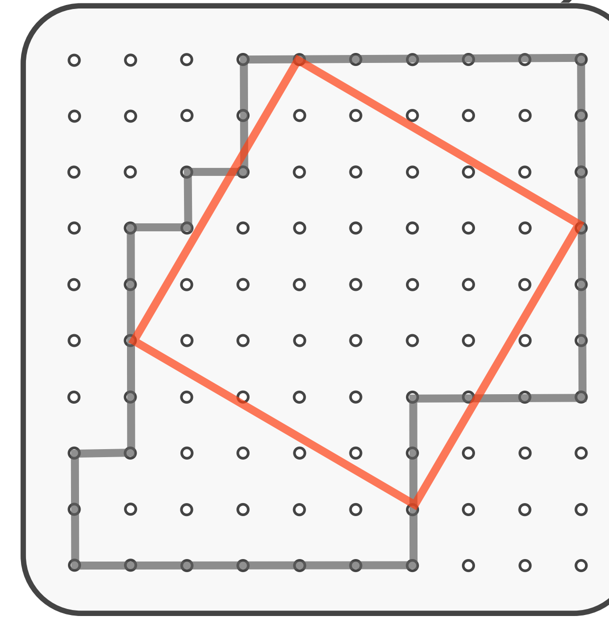
Taxi Cab Squares

Wayne

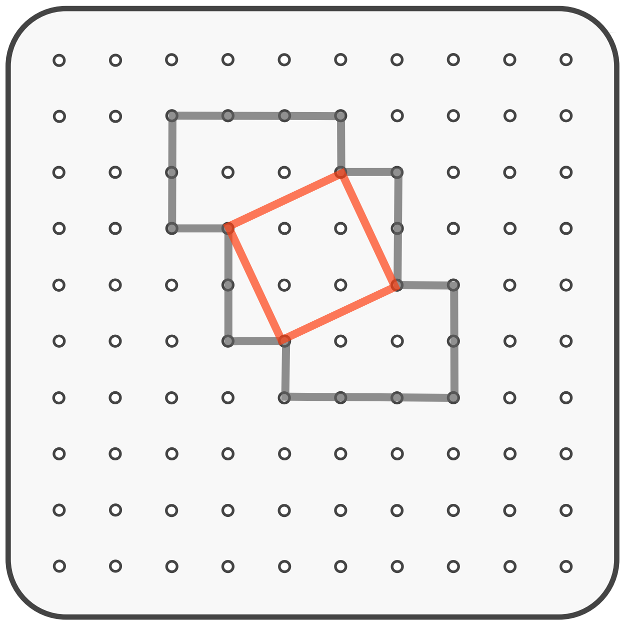


one of at least two answers for each puzzle

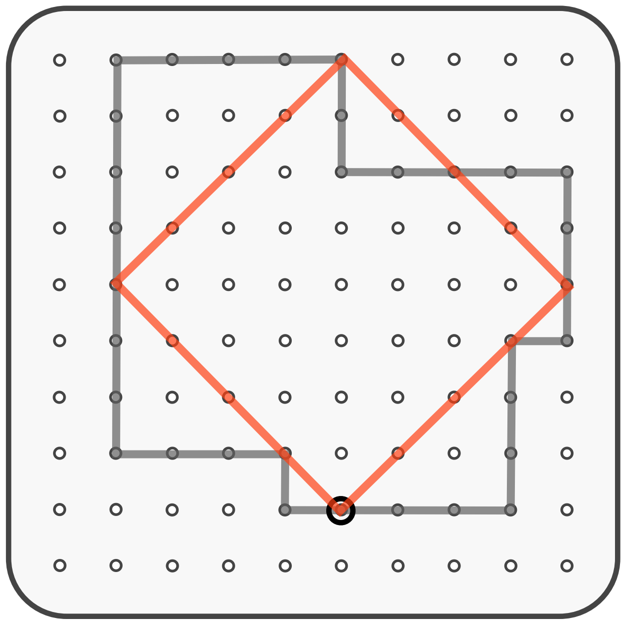
Bailey



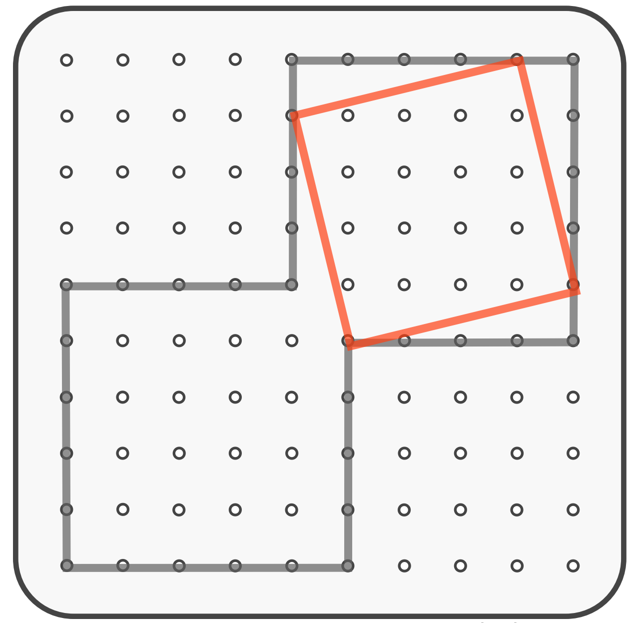
William



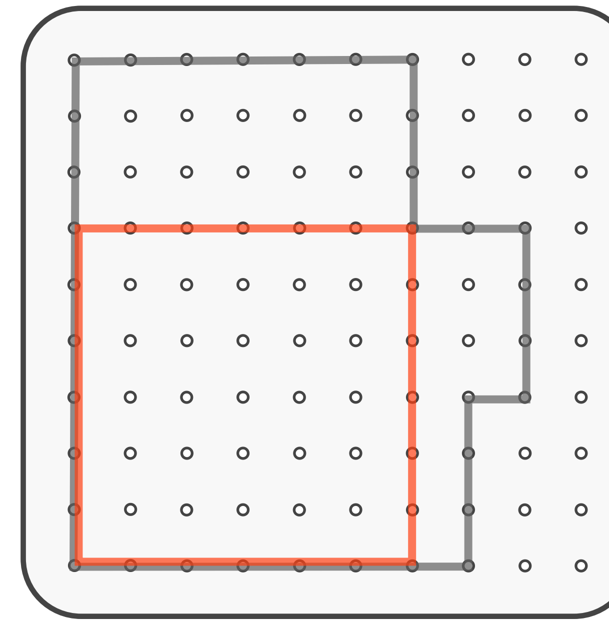
Isabella



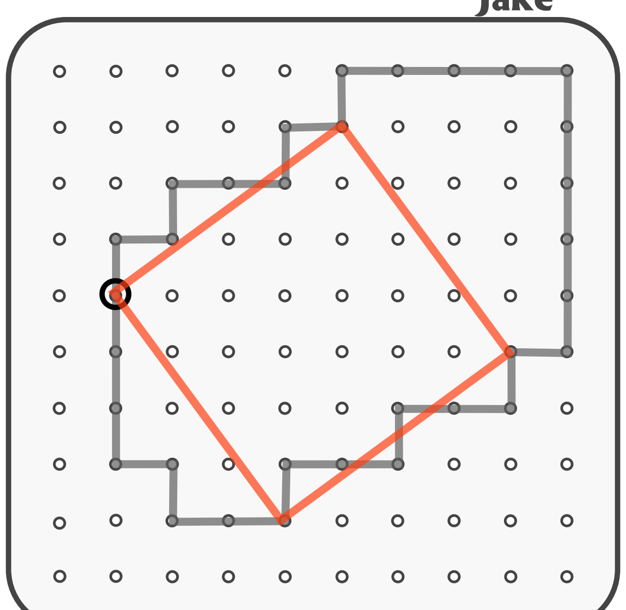
Sasa



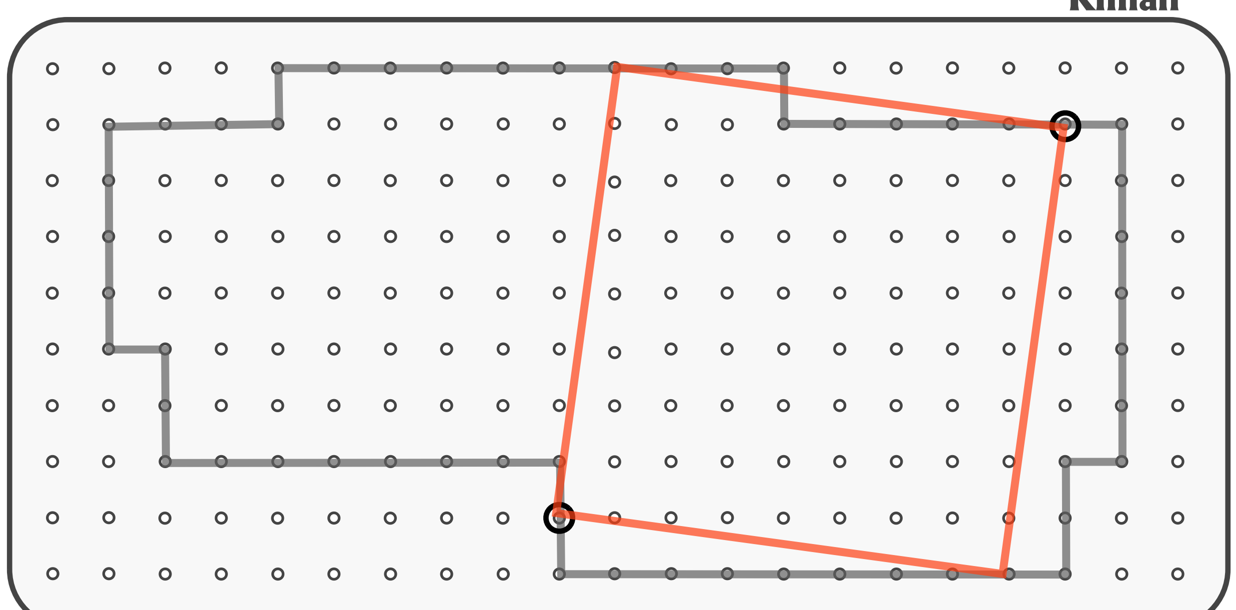
Yousra



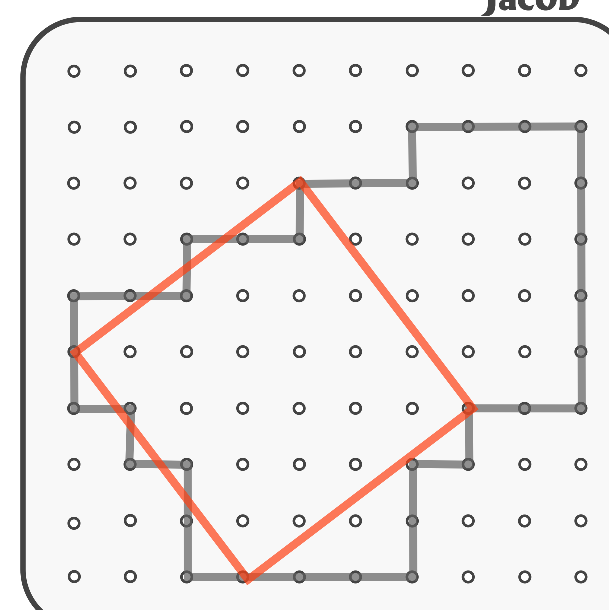
Jake



Killian



Jacob



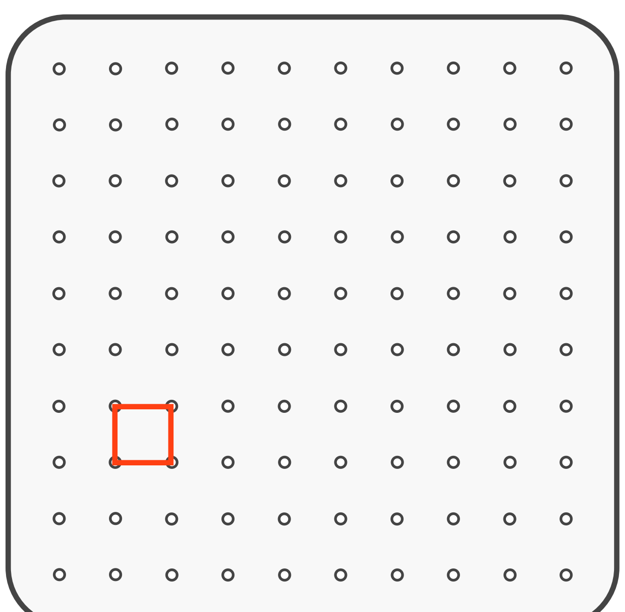
$100 Taxi Cab challenge

Perhaps some of your students have created a taxi cab loop that nobody in the class can solve... or a student who is not usually excited about math has become engaged. Perhaps a pair of students discovered a general rule that allows them to efficiently find solutions in taxi cab loops that are created just so... Whatever your inspirational experience with this gem of a puzzle, I'd like to know.

I'll offer $100 for a photograph and/or story highlighting Taxi Cab Squares in the classroom.

All students featured must have appropriate consent. All photographs and stories submitted may be used in an updated version of this pdf file and to promote this puzzle elsewhere.

Send submissions to gord@mathpickle.com. Use "$100 Taxi Cab challenge" as the subject of the email. The winning classroom will be announced the first March 14th that I have at least 10 submissions from different schools. I hope this will be March 14th, 2016.



$500 Taxi Cab challenge

Make two taxi cab loops.

The first one must have exactly one solution and fit inside the 10x10 grid on the right, but it must be bigger than the silly little 1x1 square shown on the left.

The second loop must have zero solutions, but can be on any size of grid. In the case of a tie, the solution with the smallest area inside the loop wins the prize.

If you can find both, it is worth $500 for your class. To claim your prize contact gord@mathpickle.com and use "$500 Taxi Cab challenge" as the subject of the email. I do not know if this is possible. Only one submission per class please.

The winning classroom (if any) will be announced on March 14, 2016.

Taxi by Alden Jewell

◆ Taxi Cab Squares ◆

Make a loop for your friend or enemy. They must try to find a square with all 4 corners on the loop. You win if they can't find such a square in one minute.
Do all loops have such a square?
Are there always at least two such squares on every loop??

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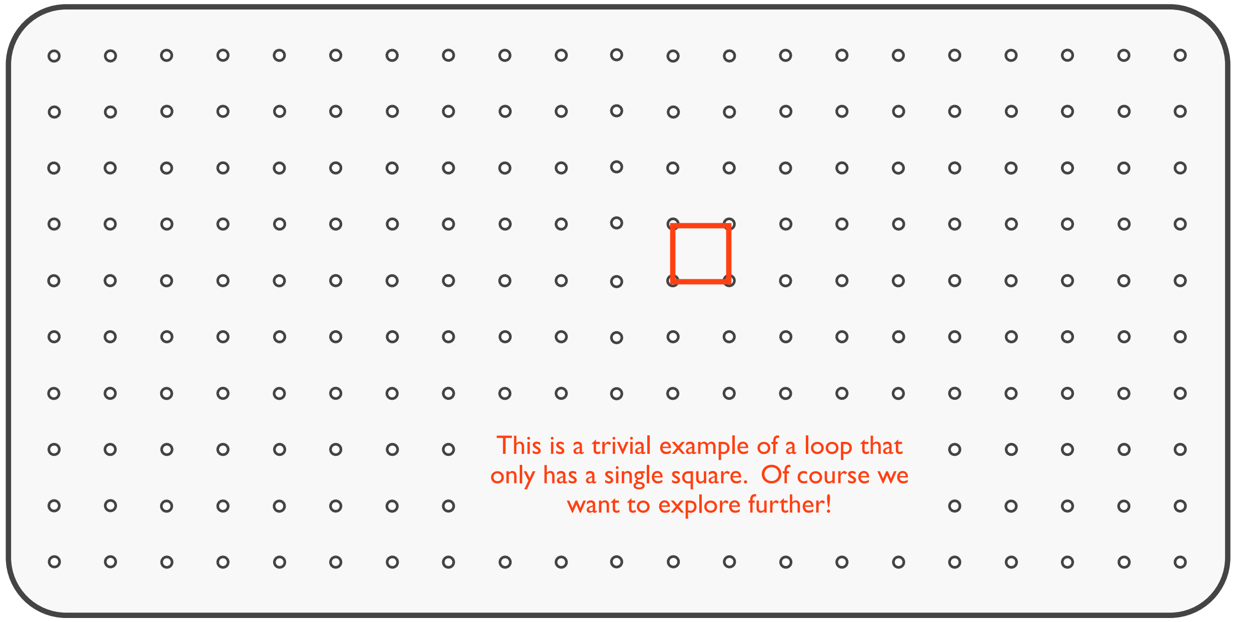
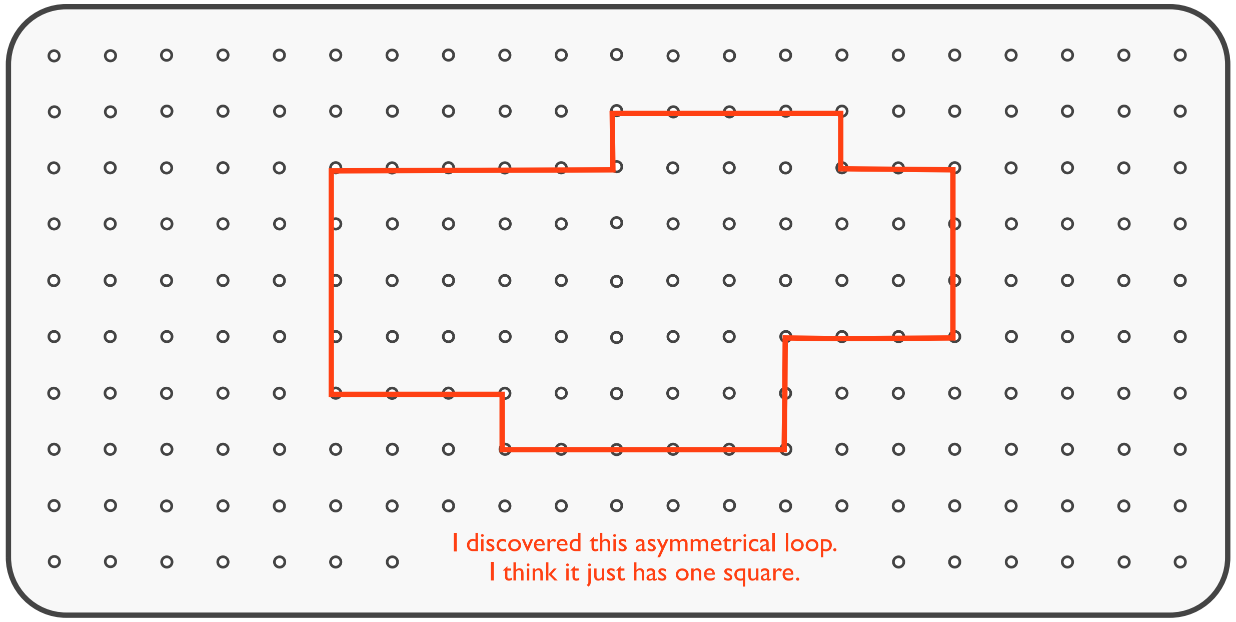
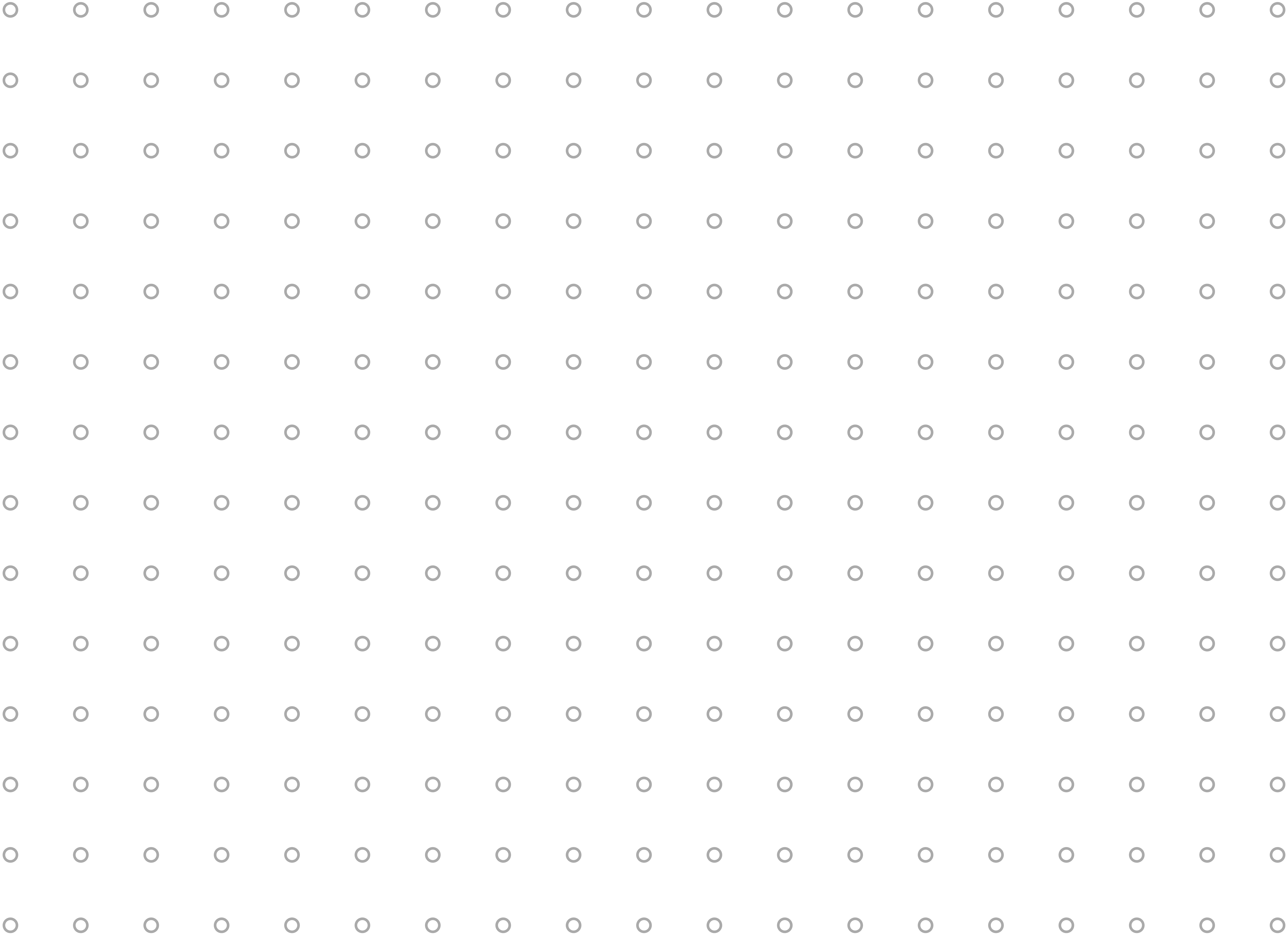
I don't know the answer to the first question, but the answer to the second question is "No."

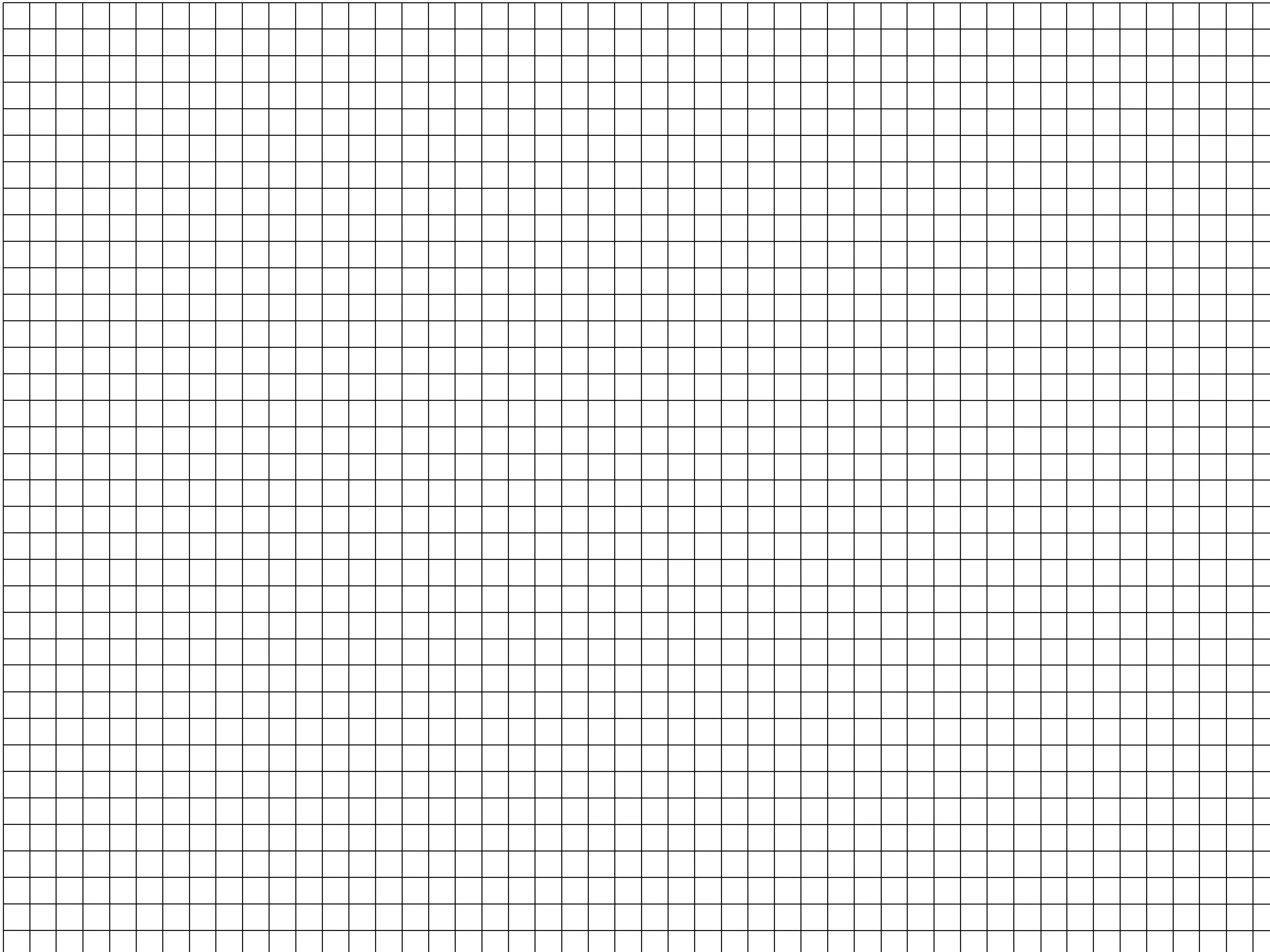


This is a trivial example of a loop that only has a single square. Of course we want to explore further!

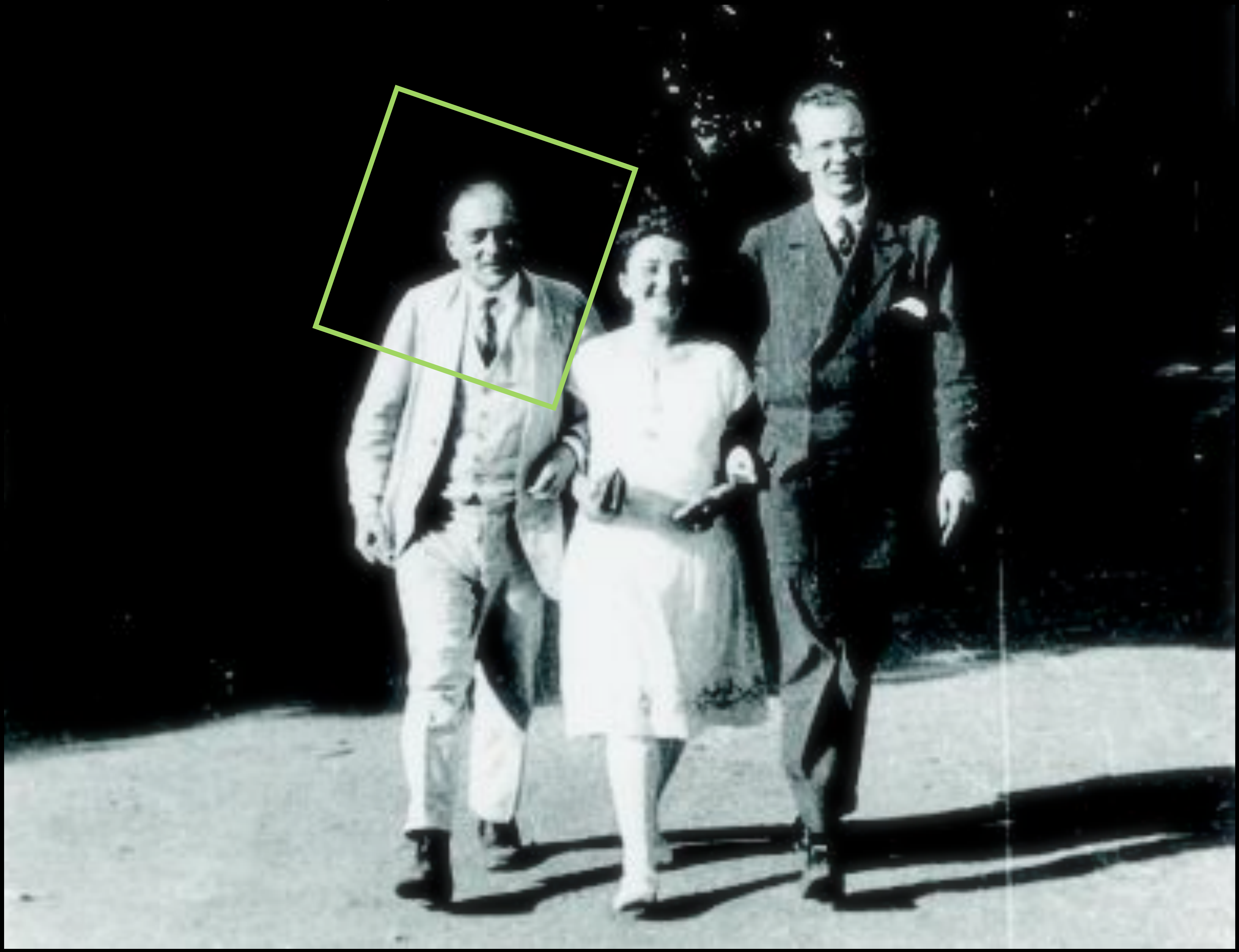


I discovered this asymmetrical loop. I think it just has one square.





This puzzle is related to an unsolved problem of Otto Toeplitz from 1911.
Here it is reinterpreted so it can be understood by ameba...



Otto Toeplitz 1881-1940

You own a pet amoeba. No matter what shape it contorts into, is it always possible that you can place a square blanket so that all four corners tickle the perimeter of your amoeba?

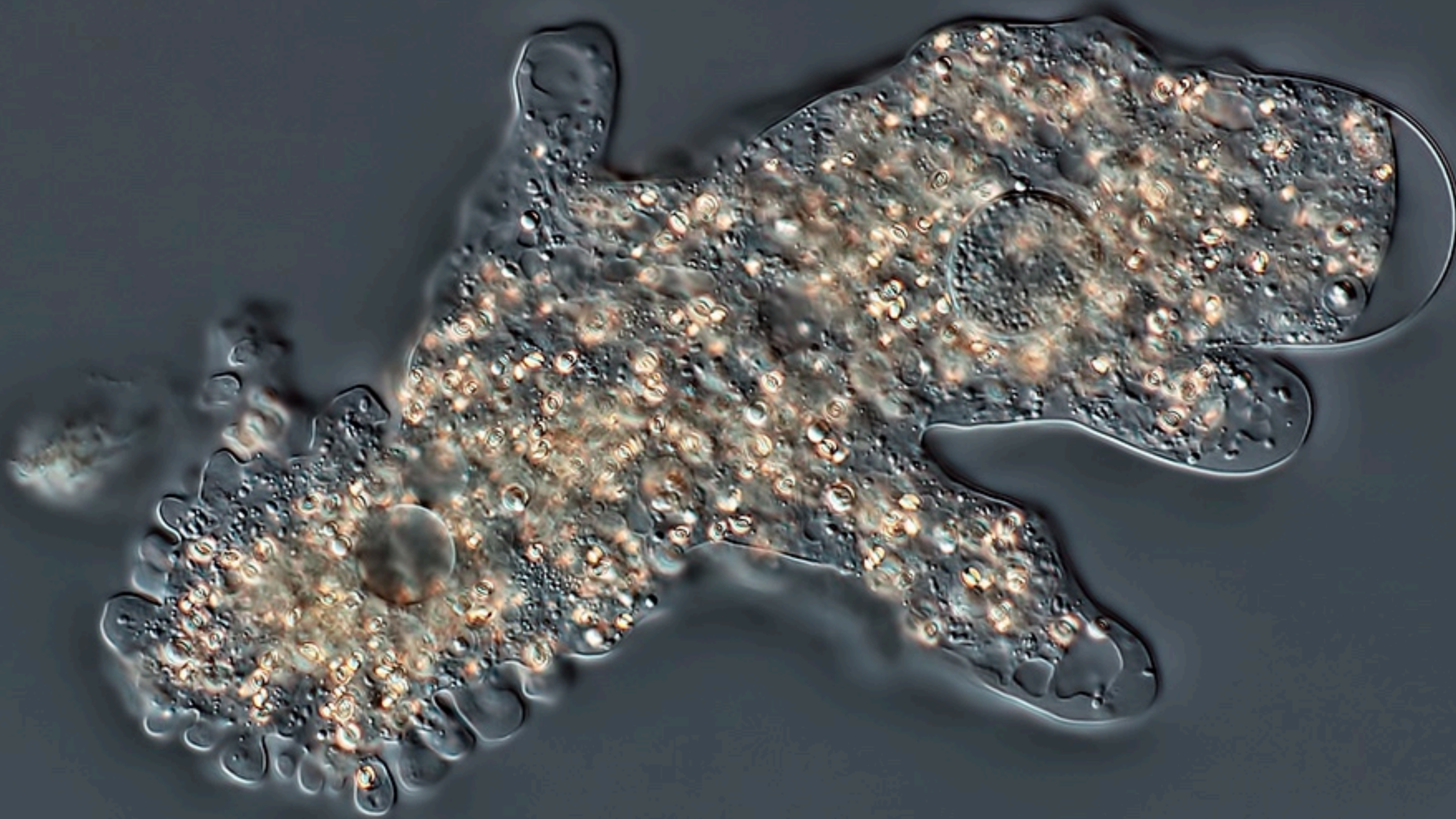


Photo by Rogelio Moreno

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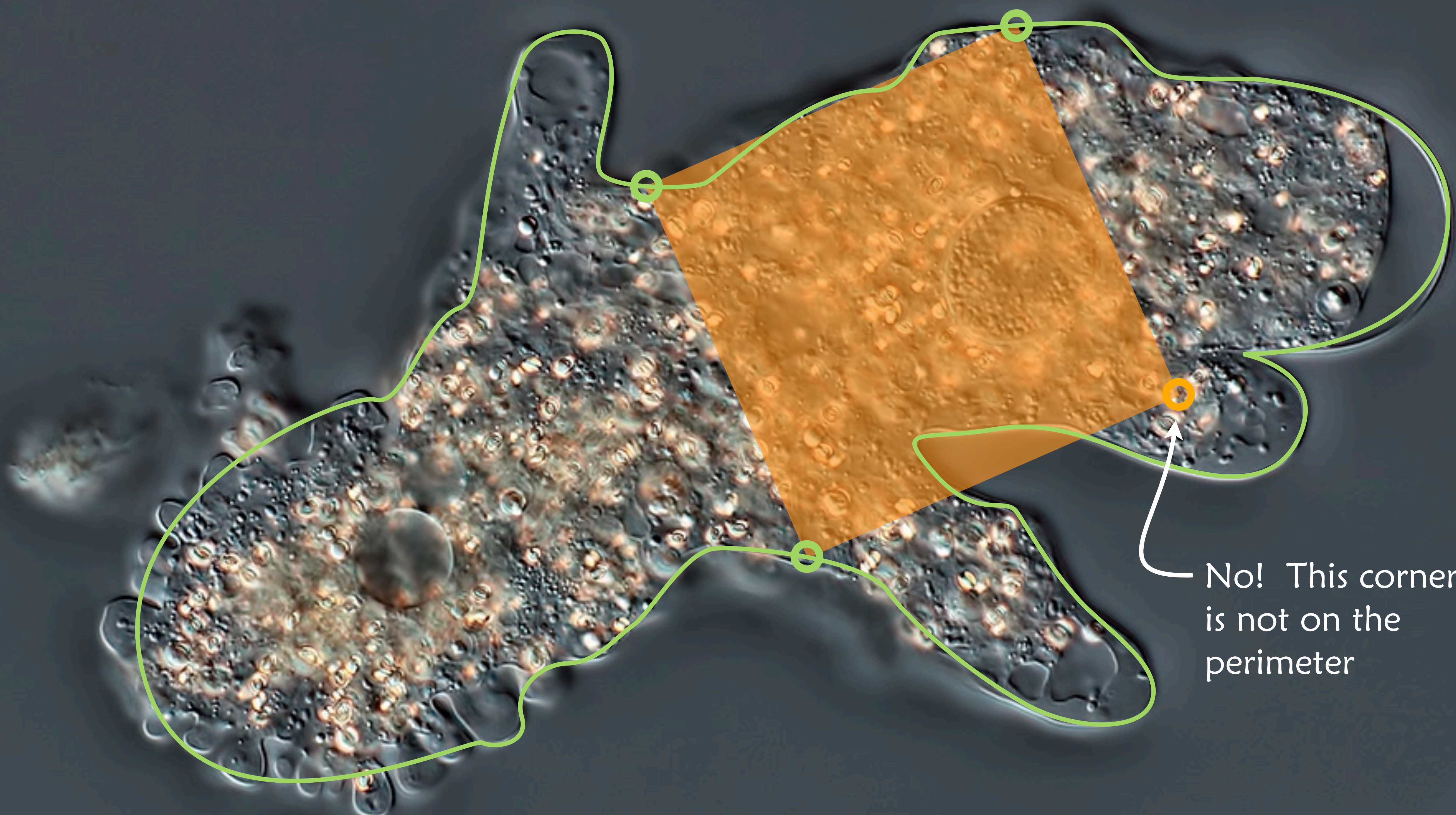

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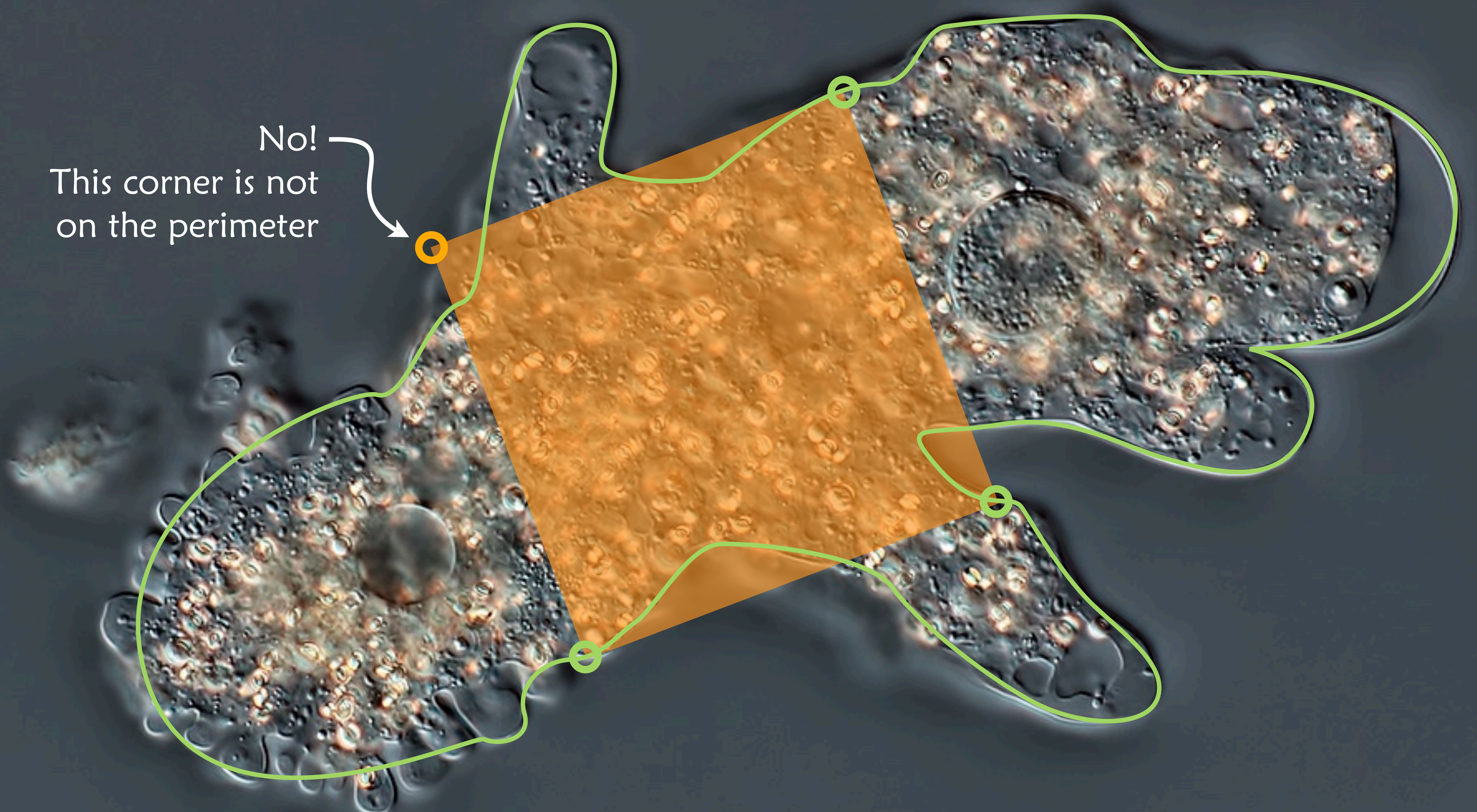

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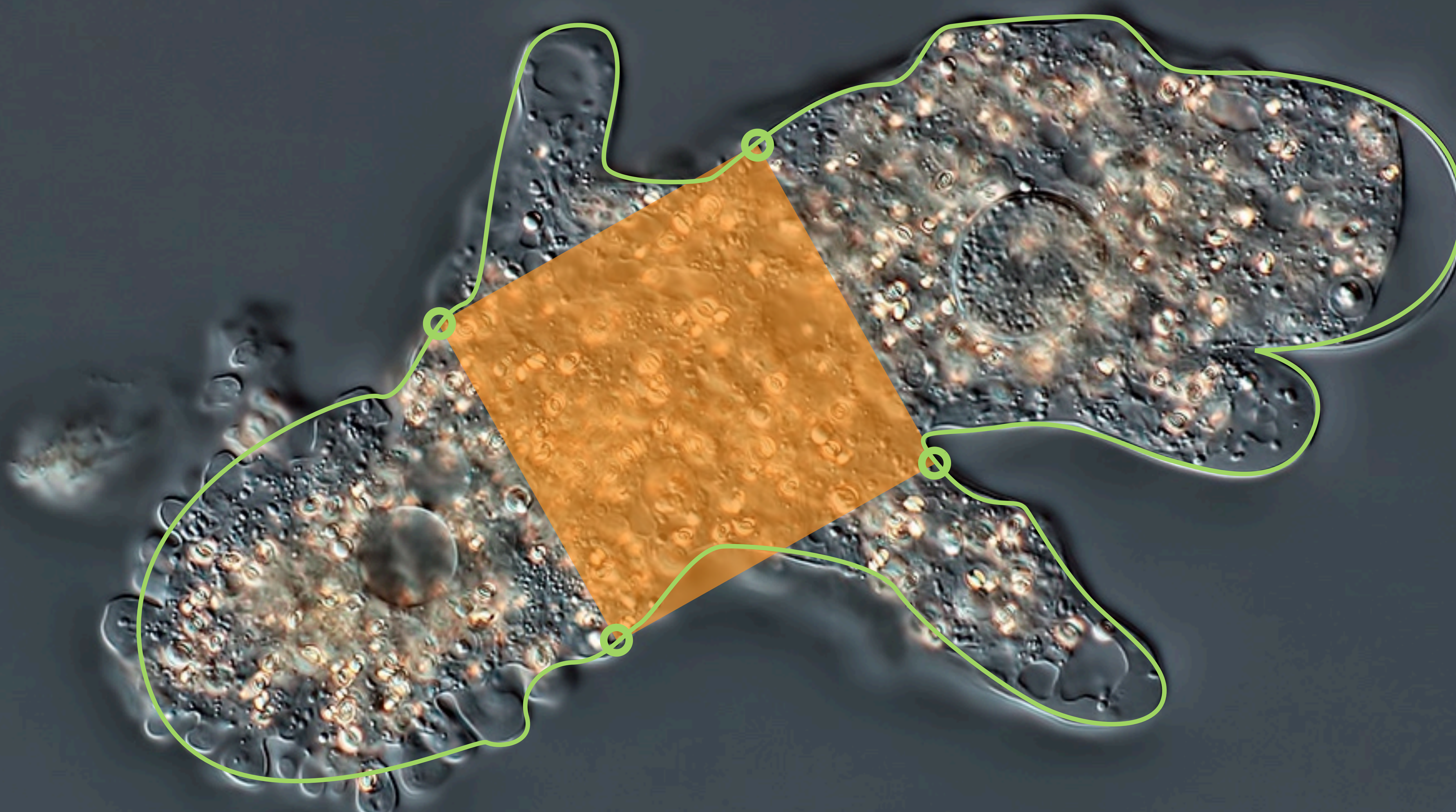
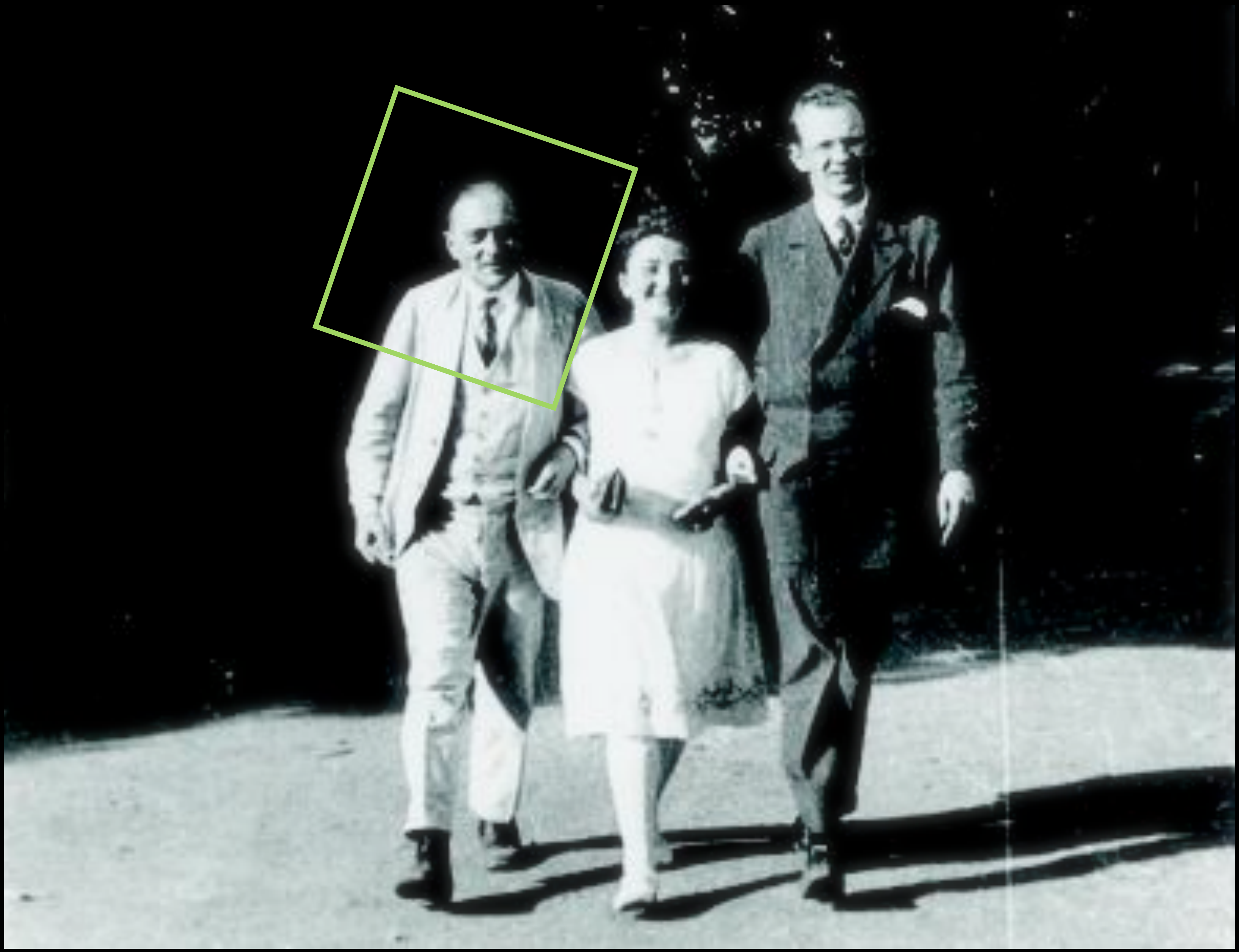


Success! ...but can you ALWAYS place such a square blanket? This was posed in 1911 by Otto Toeplitz. It remains unsolved.



Otto Toeplitz 1881-1940

Put Your Students in a Pickle!

I'm a father of two elementary school children, a mathematician, and designer of puzzles and board games. Students call me Dr. Pickle. There is nothing I enjoy more than stumping students and having them stump me.

I founded MathPickle.com in 2010 to inject new ideas into the classroom. MathPickle's primary objective is to get thirteen curricular unsolved problems into classrooms worldwide - one for each grade K-12. A conference in November 2013 established the thirteen unsolved problems. To aid with the dissemination of these awesome problems, MathPickle is looking at setting up a $1,000,000 reward for each - the prize money to be split between the person who solves the problem and their most inspirational K-12 educator.

MathPickle is also developing a range of curricular puzzles like the ones you'll find at TpT. These help teachers with their number one challenge:

"How to engage the spectrum of student ability?"

Whenever an elementary school teacher wants to teach addition, she will invariably face 20% of students who already know how to add and another 20% who are struggling with last year's curriculum. How can she engage the top students without losing the bottom students? How can she engage the bottom students without boring the top students?

One solution: Parents of top students often ask that their child be allowed to accelerate through the curriculum. This exacerbates the problem for future teachers, and sets up a failure-impoverished education experience for the bright student.

A wiser approach is to use curricular puzzles, games and mini-competitions to simultaneously teach curriculum to the students who need it, and to deflect top students into tough problem solving activities. This is never time wasted, because problem solving is the primary reason we teach mathematics.

The experience of mathematics should be profound and beautiful. Too much of the regular K-12 mathematics experience is trite and true. Children deserve tough, beautiful puzzles.

Gordon Hamilton
MMath, PhD