

5 Favourite Problems for Intermediate Mathematics

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Chris Hunter

K-12 Numeracy Helping Teacher

Surrey Schools

email: hunter_c@surreyschools.ca

Bluesky: [@chrishunter.bsky.social](https://bsky.social/@chrishunter)

blog: chrishunter.ca



“Good **problem-solving** tasks require students to get **stuck** and then to think, to experiment, to try and to fail, and to apply their knowledge in novel ways in order to get **unstuck**.”

Liljedahl, P. (2021). *Building thinking classrooms in mathematics, grades K-12: 14 teaching practices for enhancing learning*. Corwin.



*What (else) makes a
good problem good?*

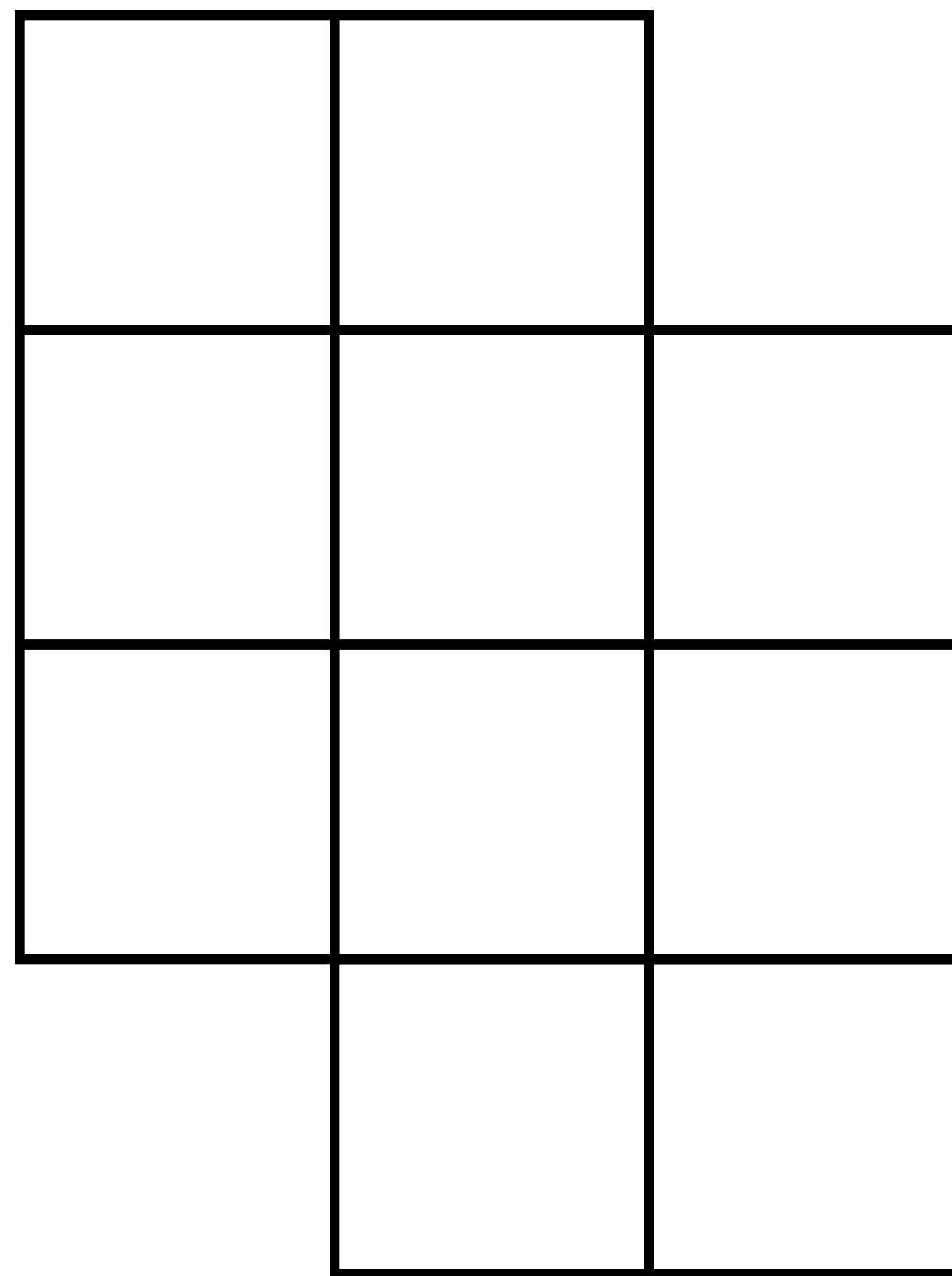
5

Next Door Numbers

Liljedahl, P. & Giroux, M. (2024). *Mathematics tasks for the thinking classroom, grades 5-12*. Corwin.

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1 2 3 4 5 6 7 8 9 10



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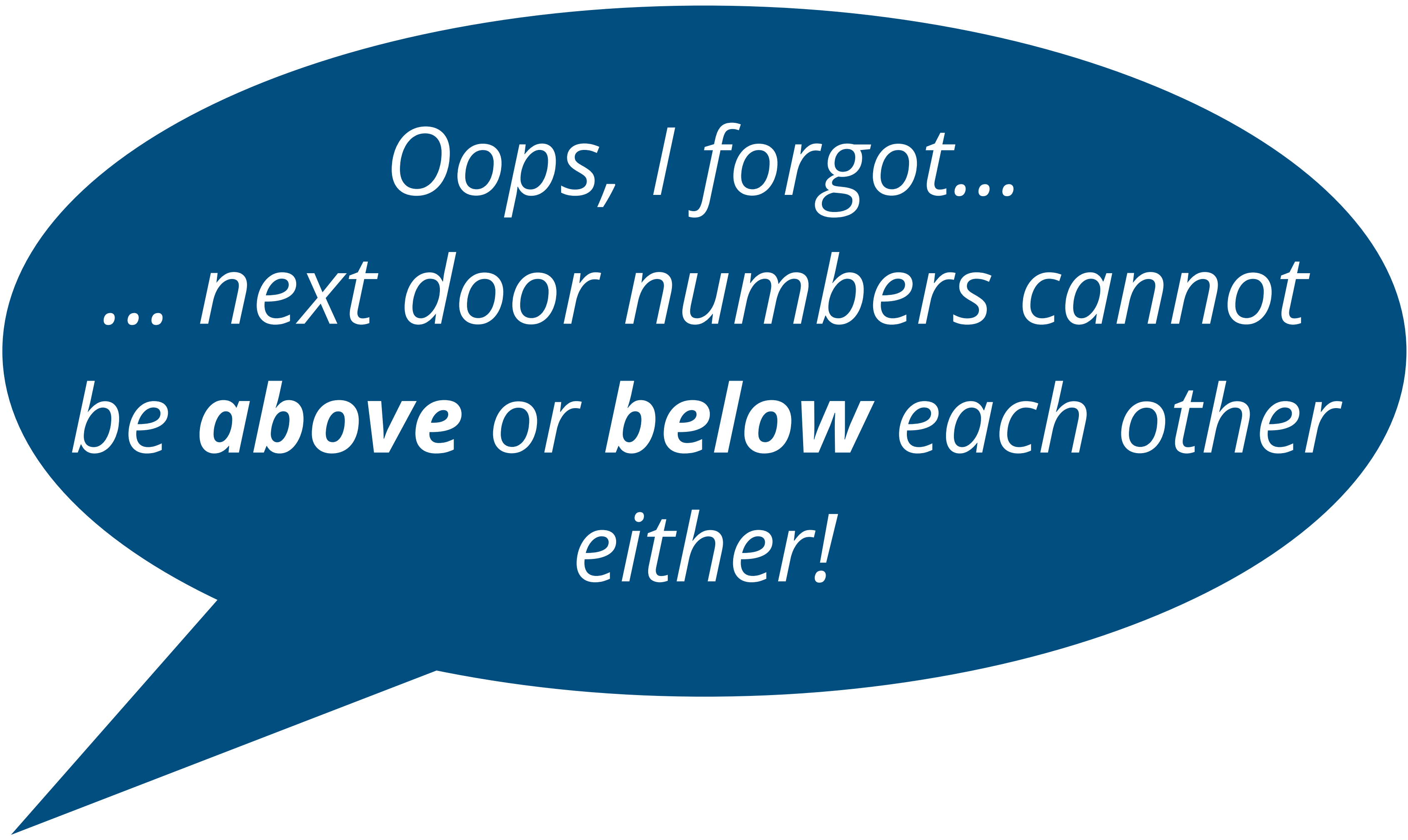
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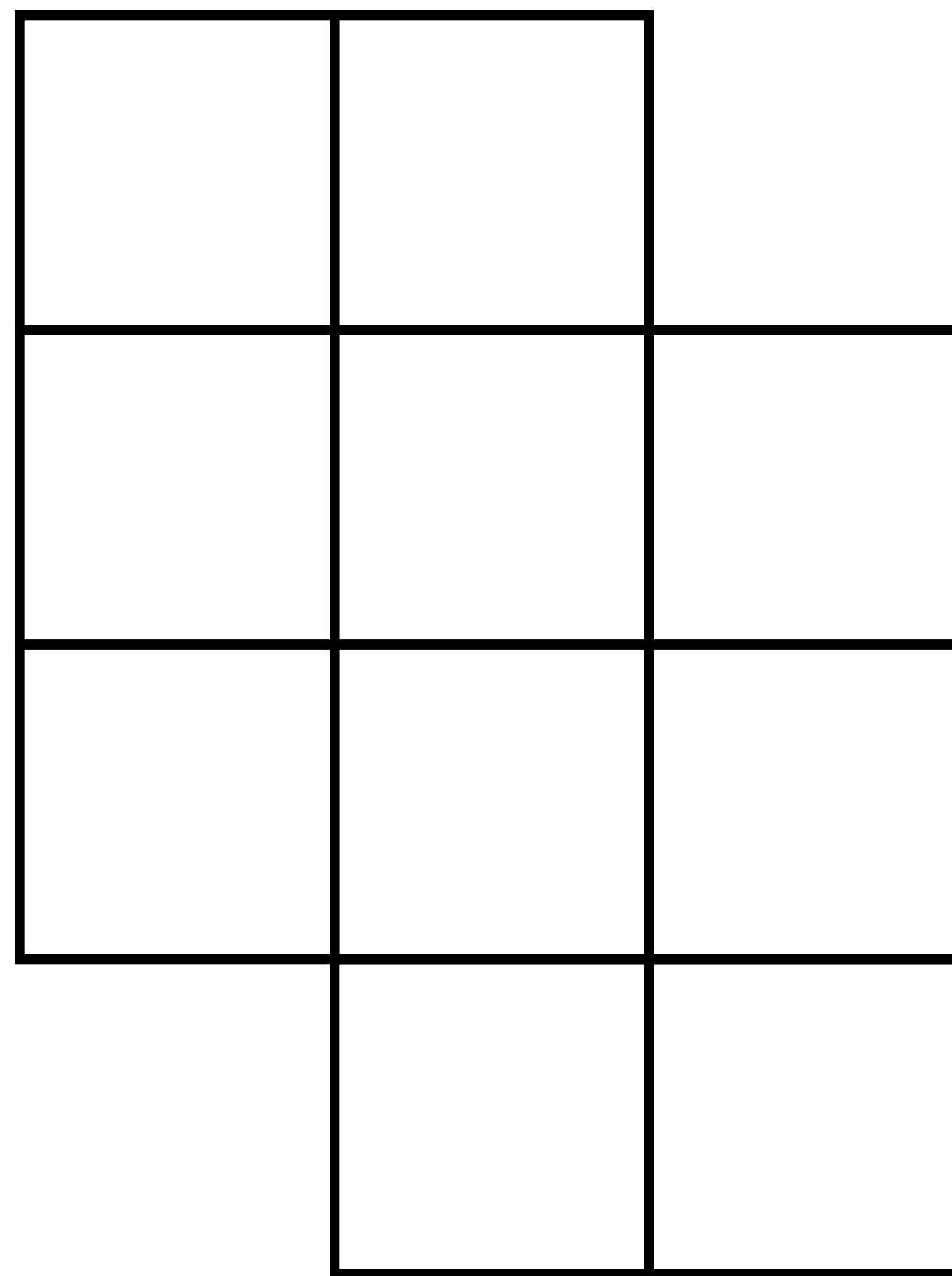
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Oops, I forgot...



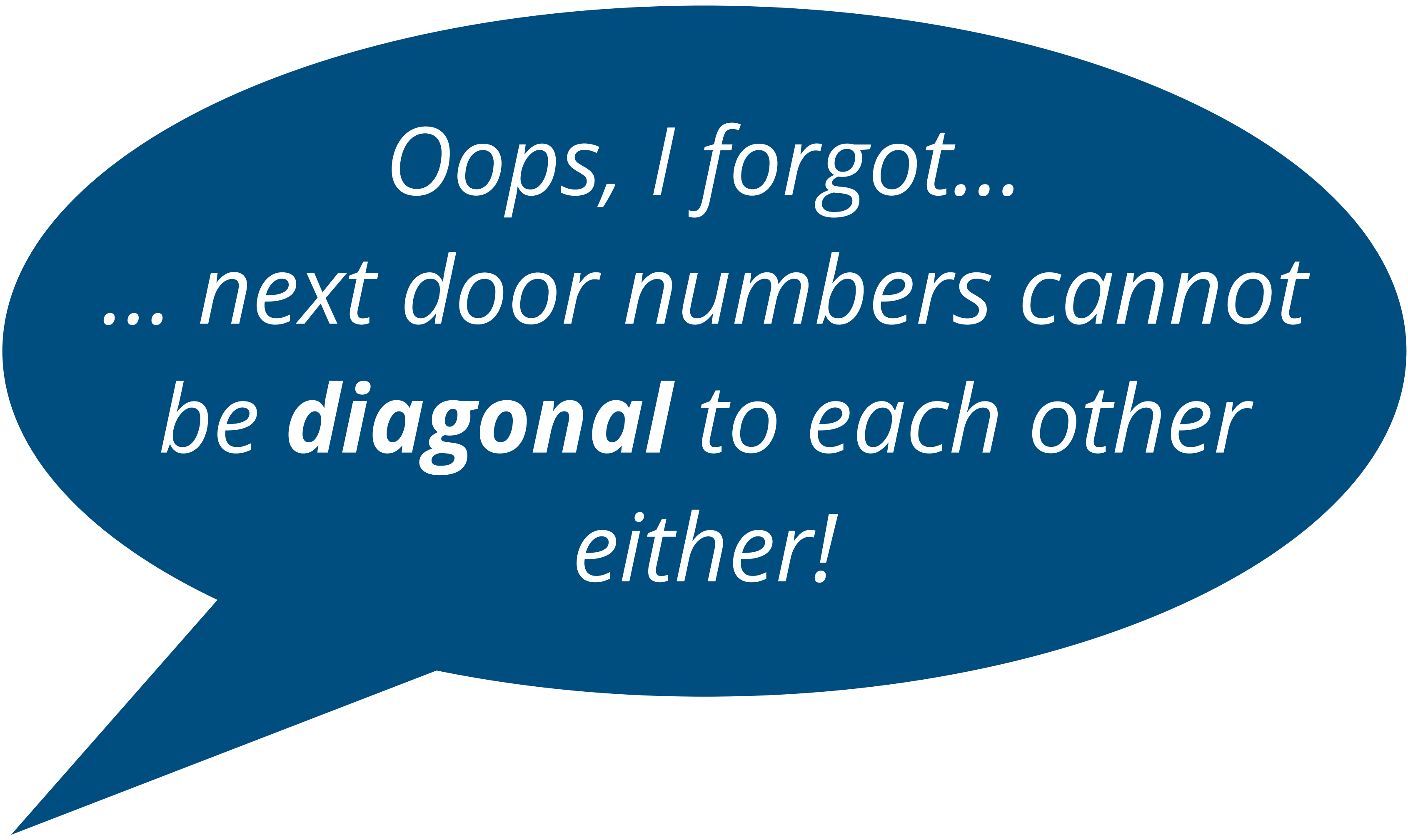
Oops, I forgot...
... next door numbers cannot
*be **above** or **below** each other*
either!



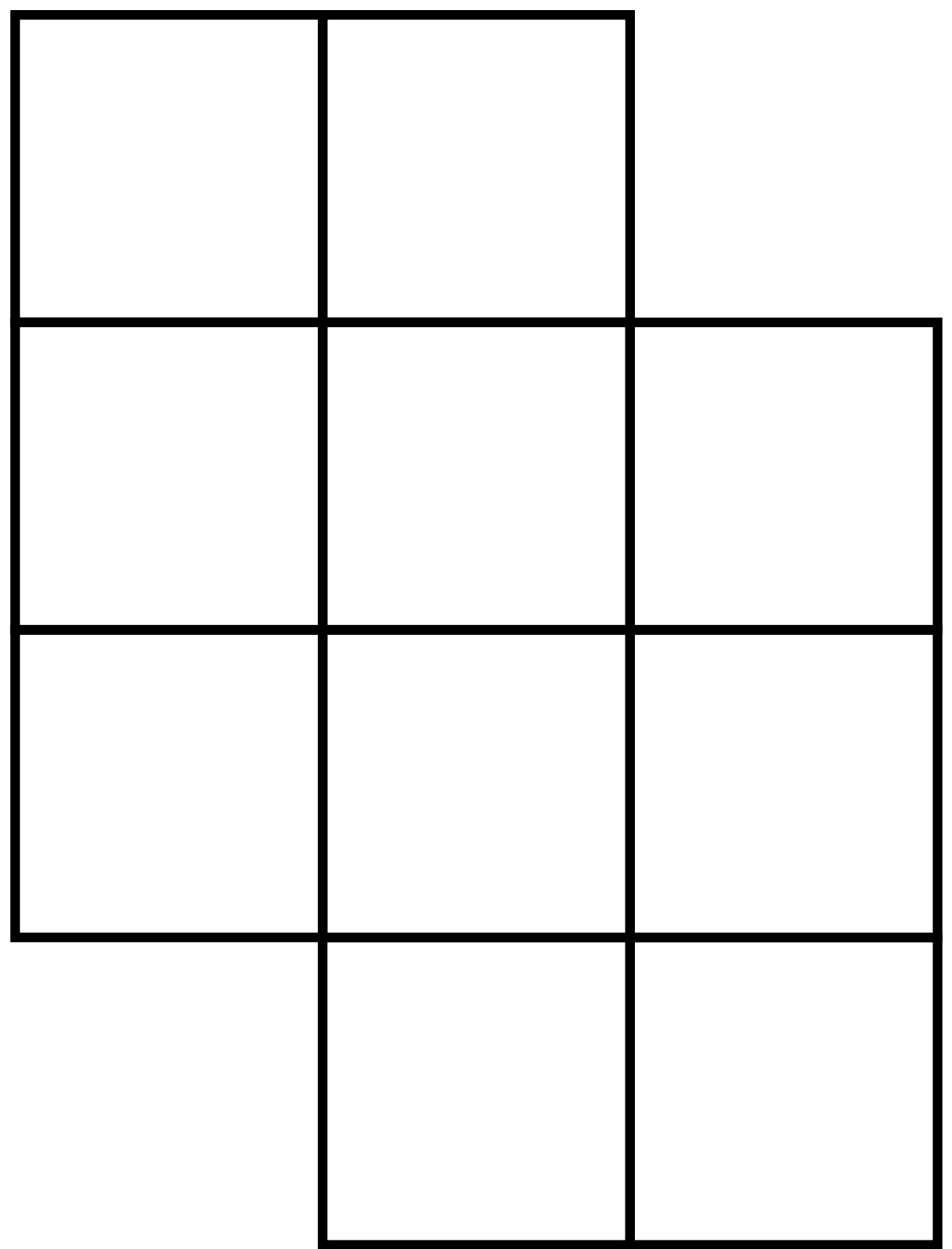
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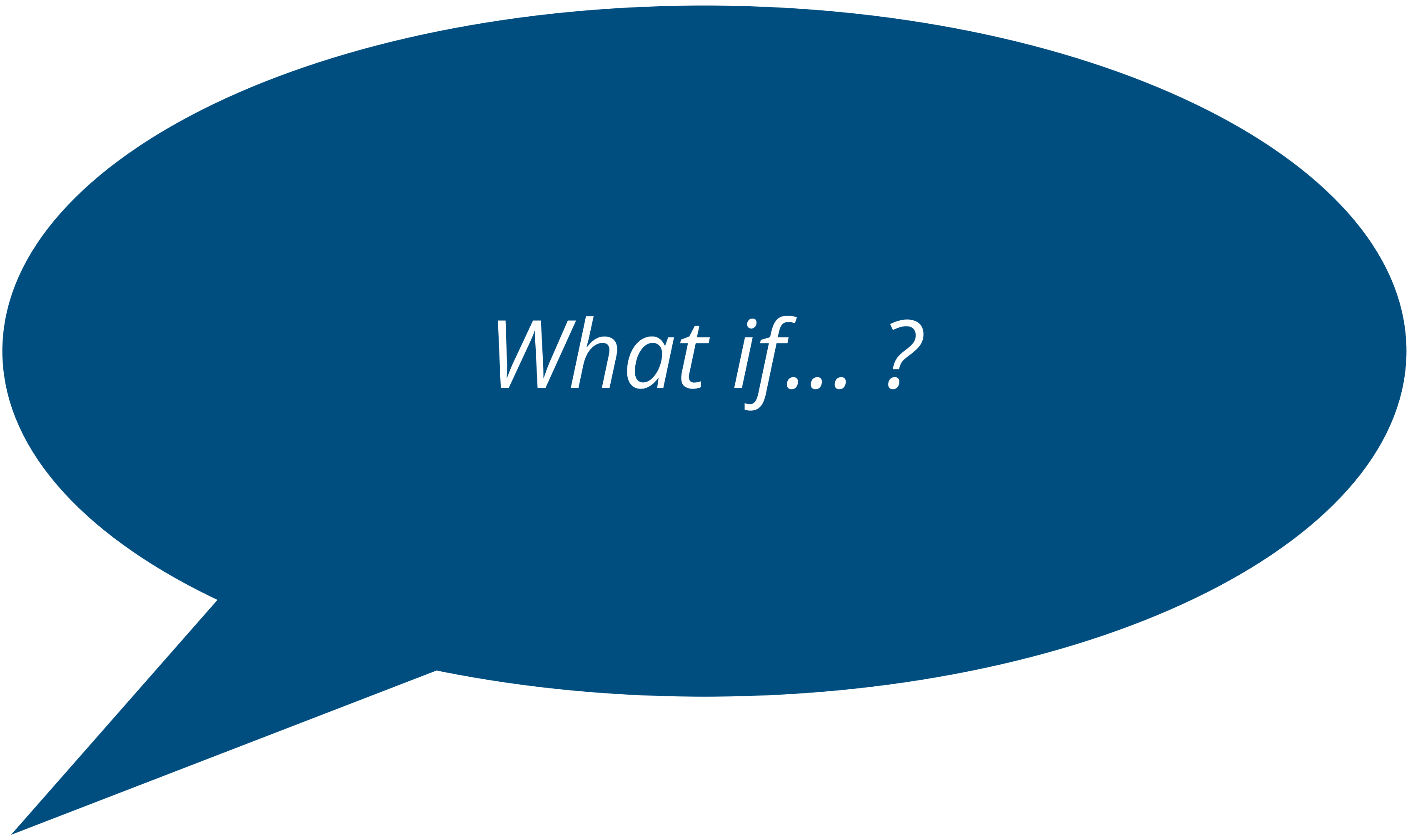
Oops, I forgot...



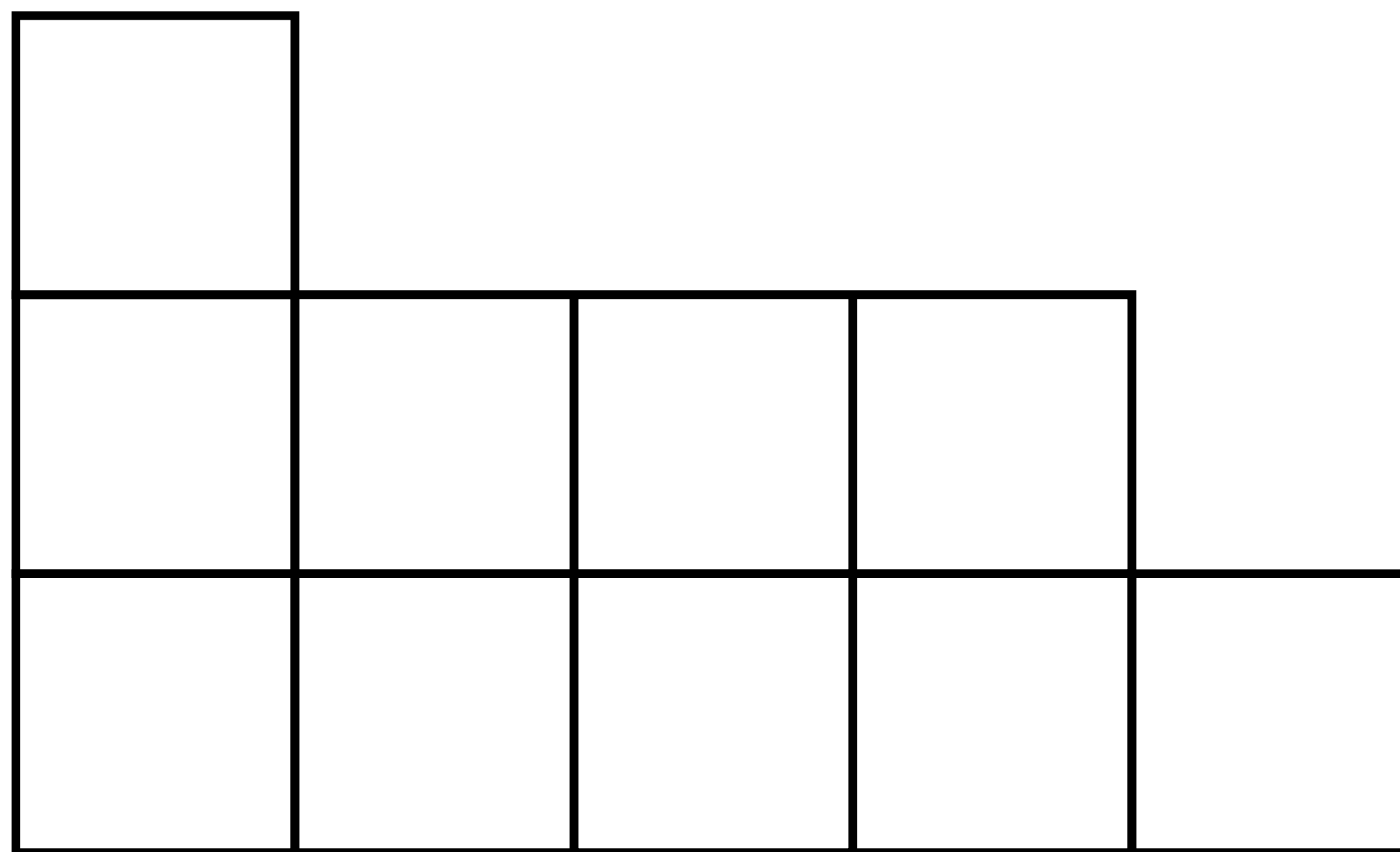
Oops, I forgot...
... next door numbers cannot
*be **diagonal** to each other*
either!



1 2 3 4 5 6 7 8 9 10



What if... ?



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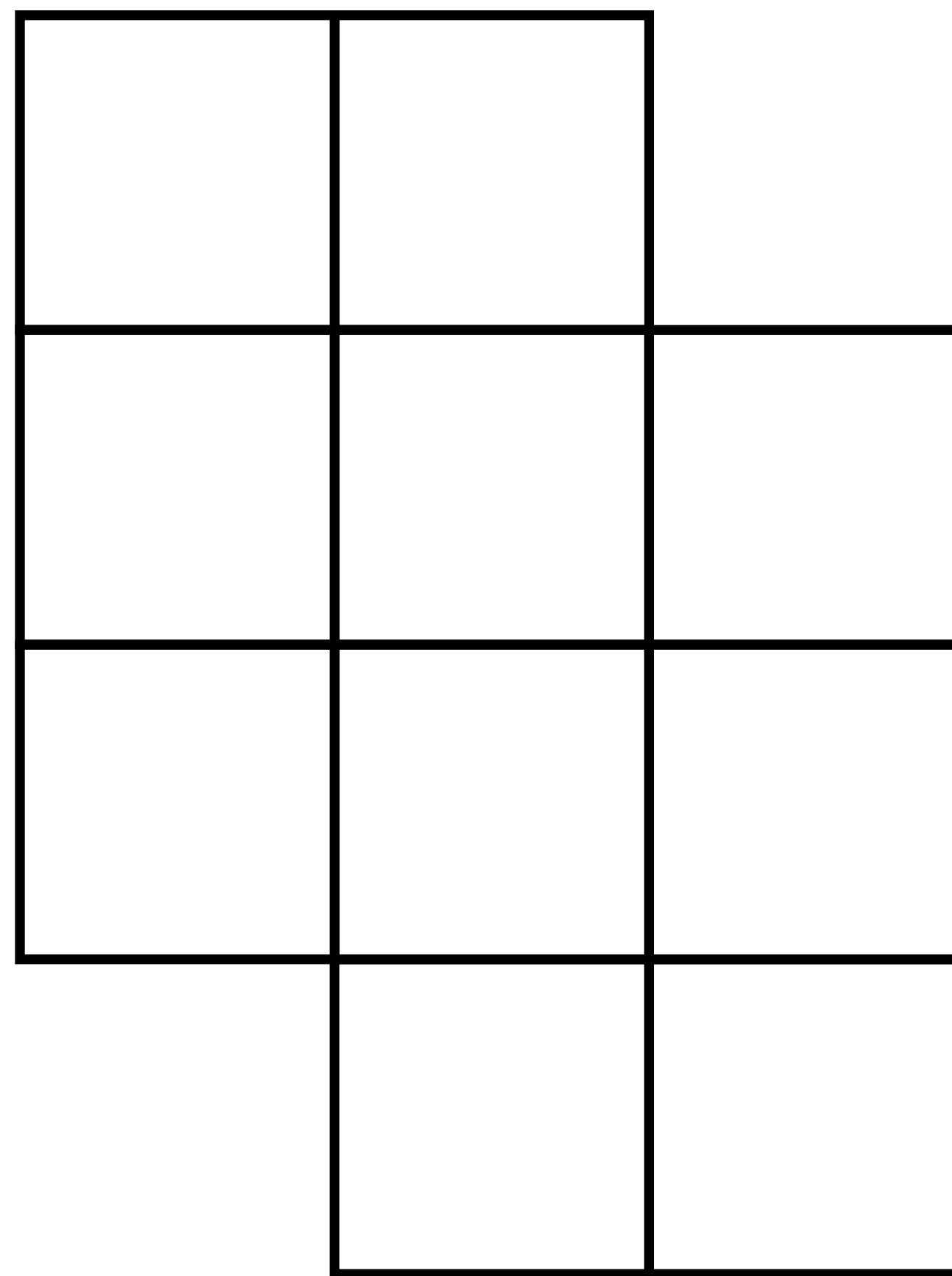
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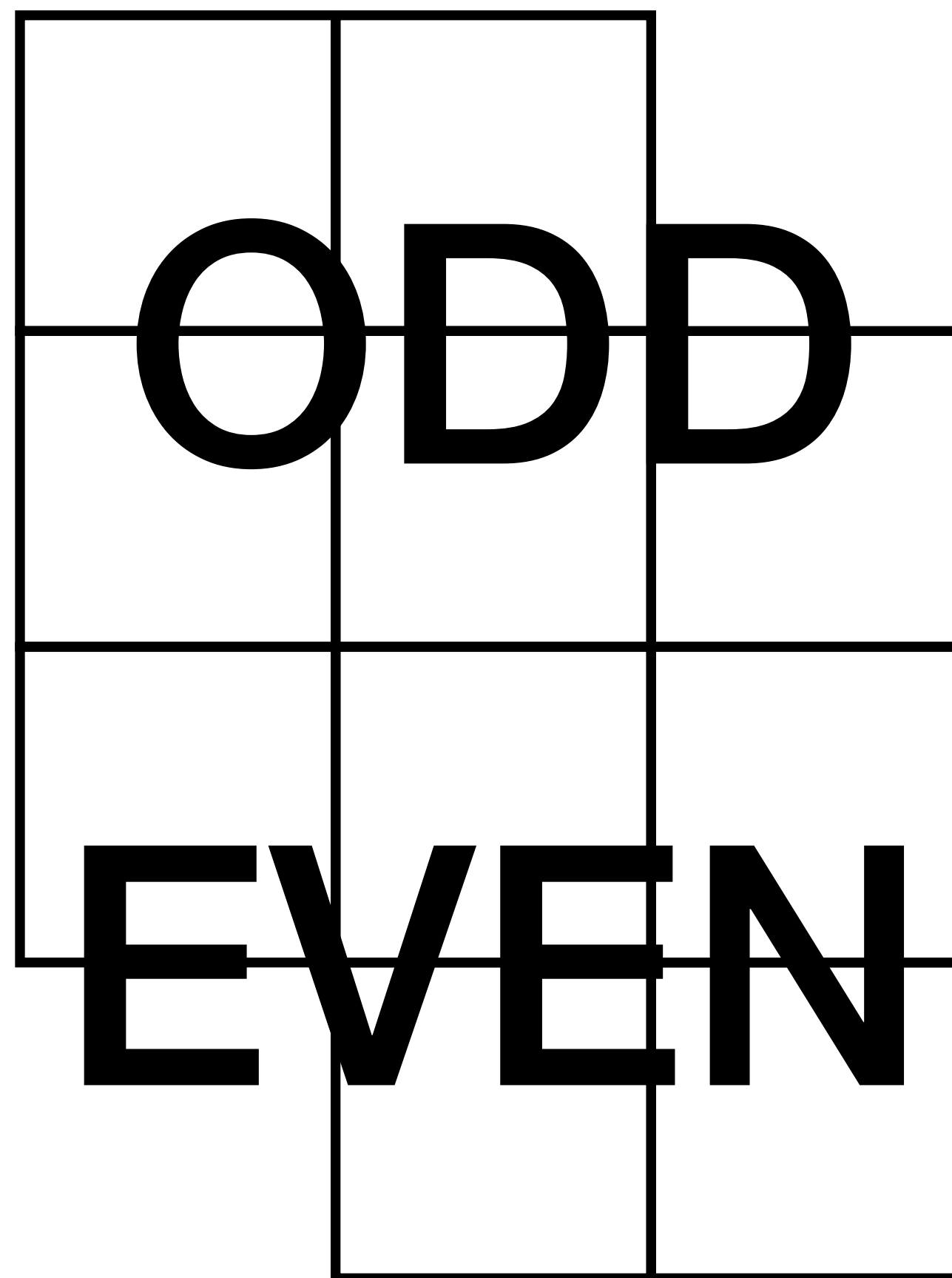
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1 2 3 4 5 6 7 8 9 10



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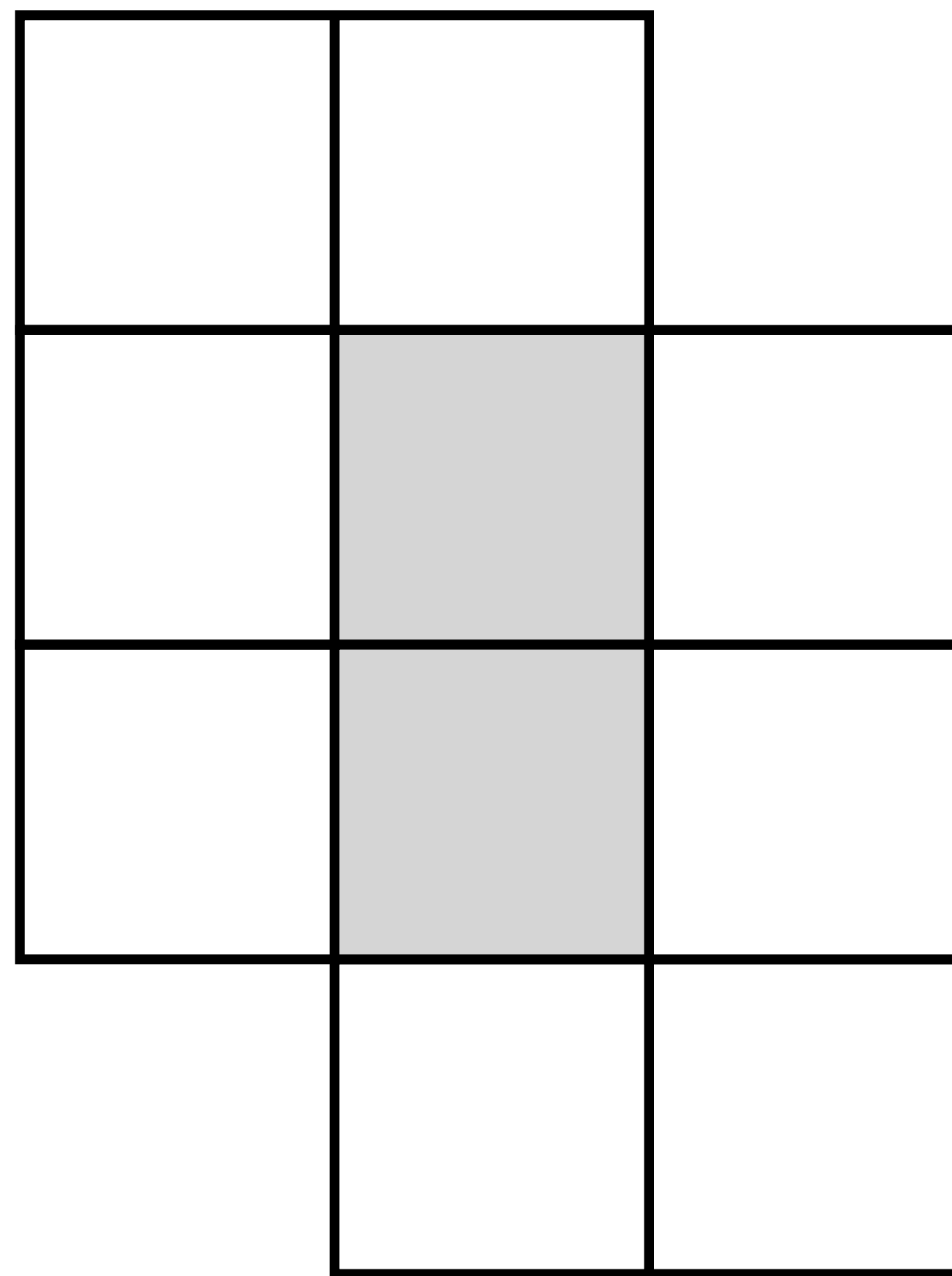
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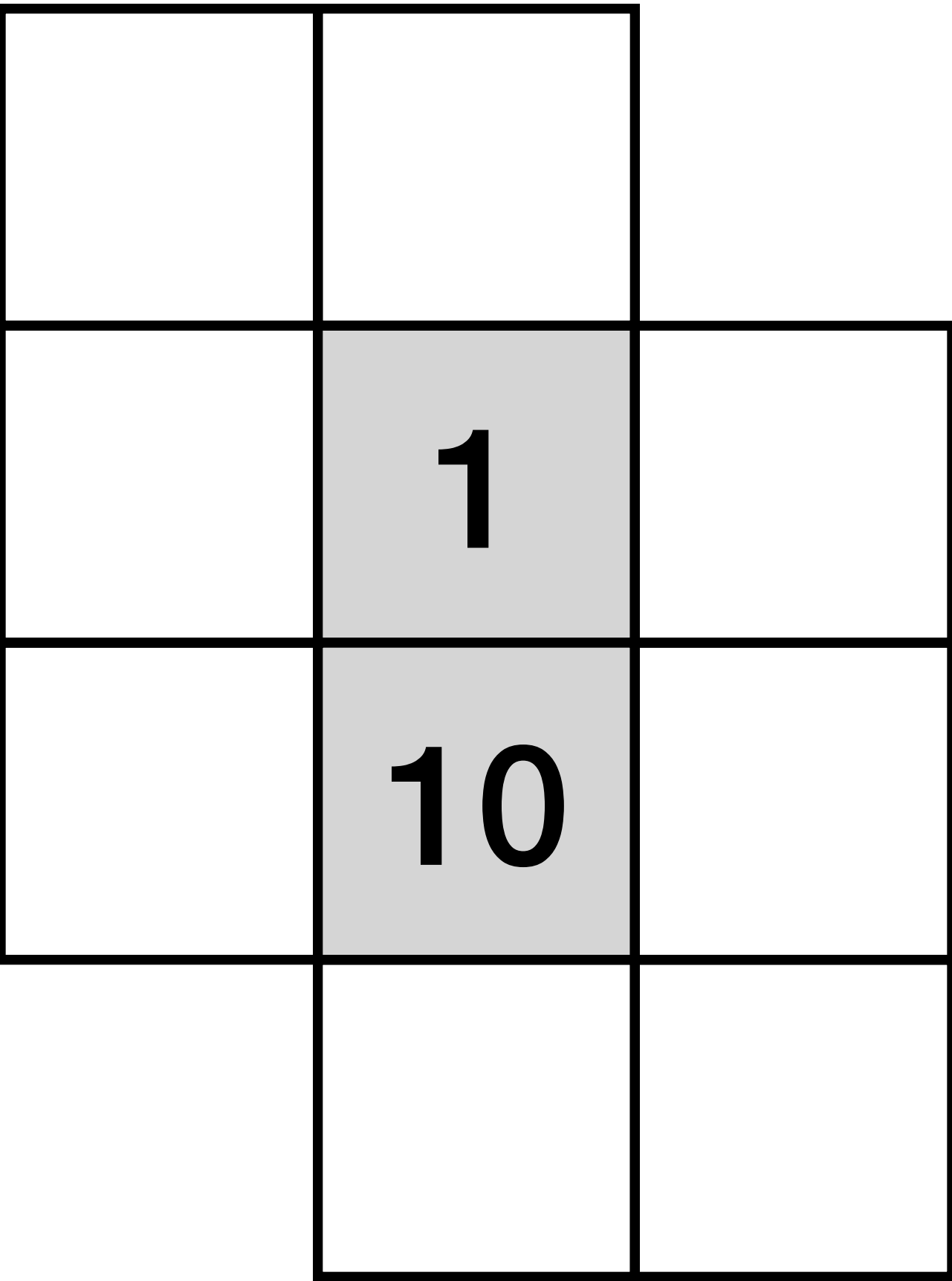
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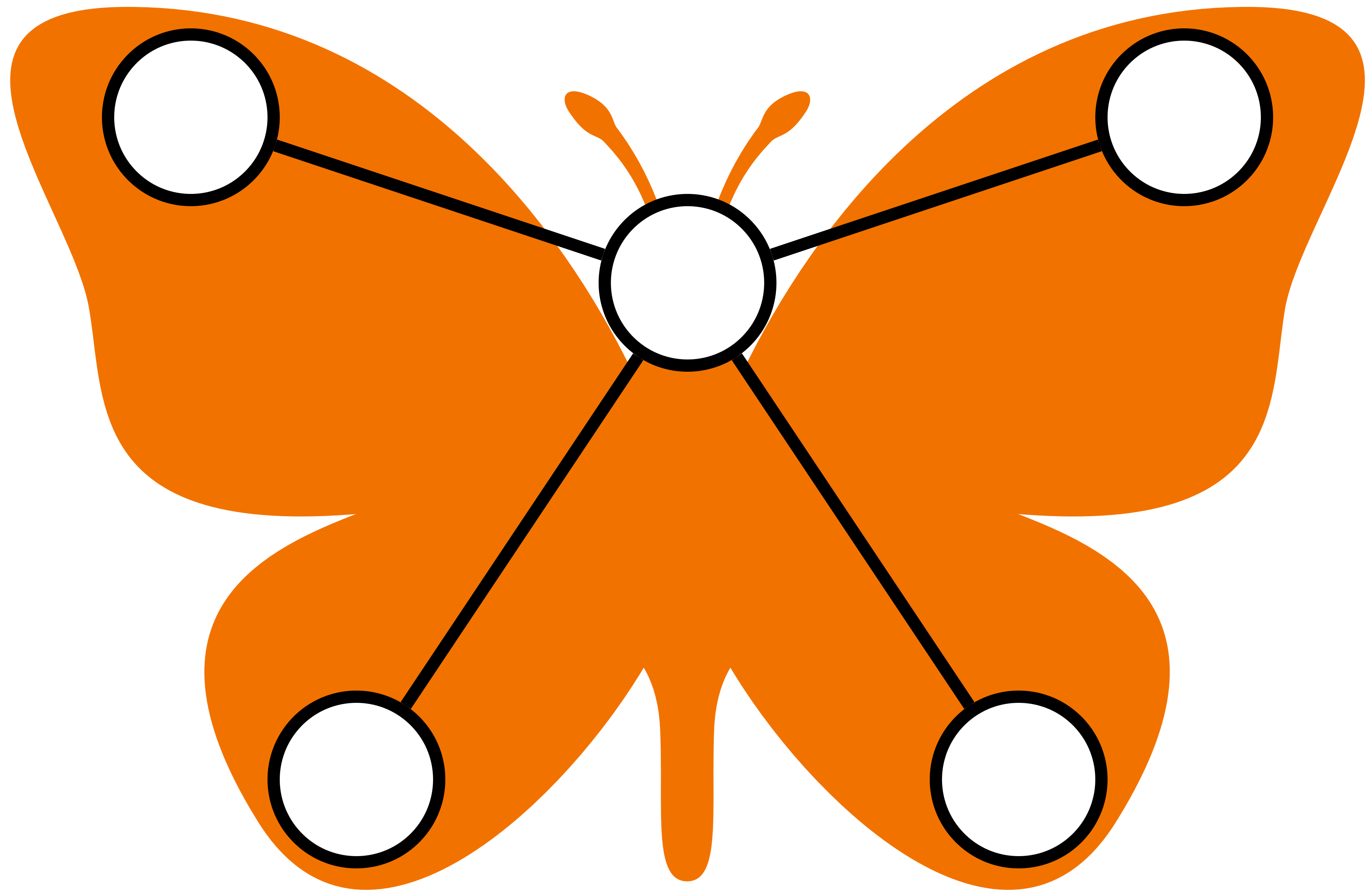
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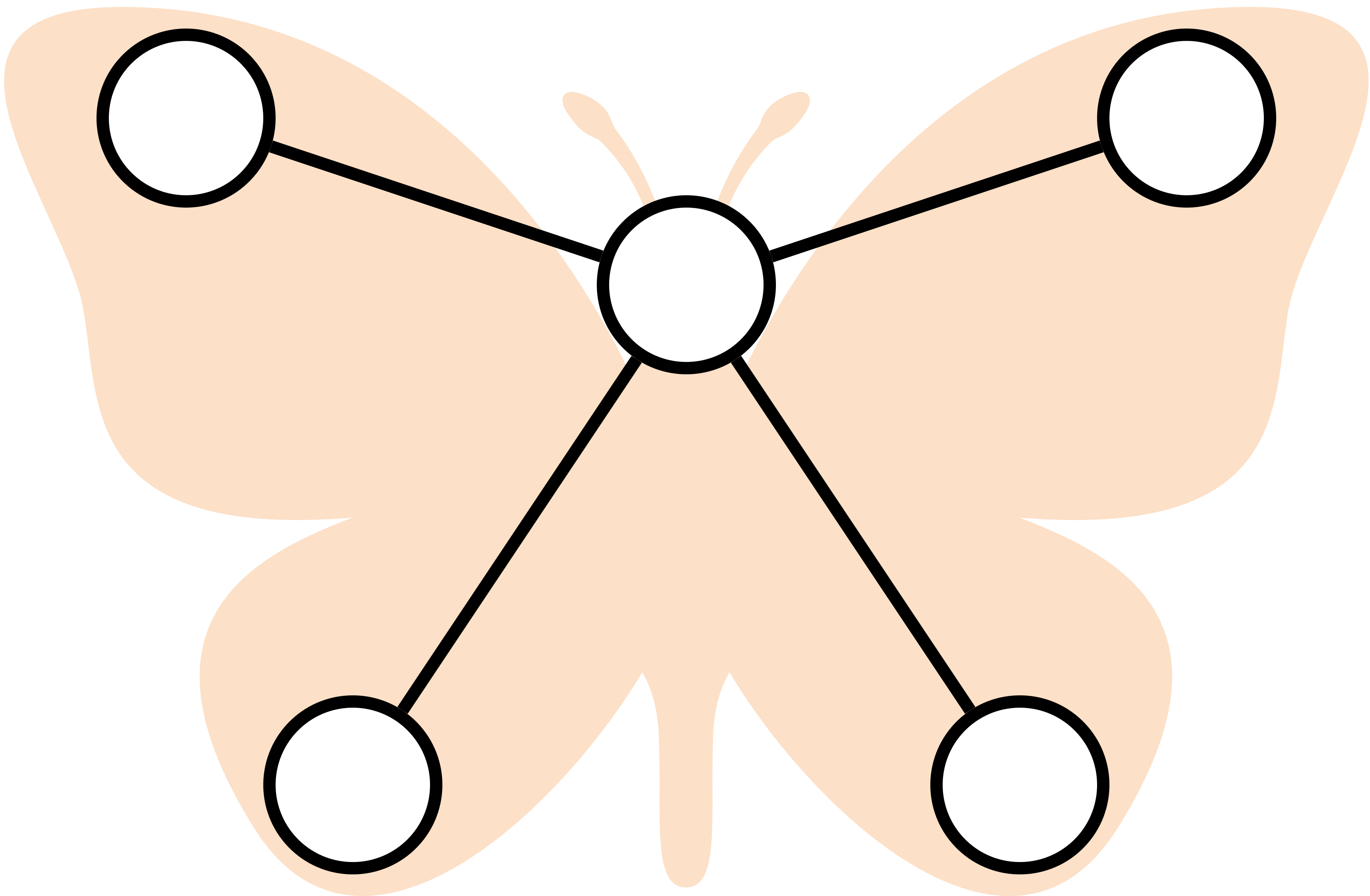


2 3 4 5 6 7 8 9

Graceful Tree Conjecture

Animal subtraction. MathPickle. <https://mathpickle.com/project/animal-subtraction/>





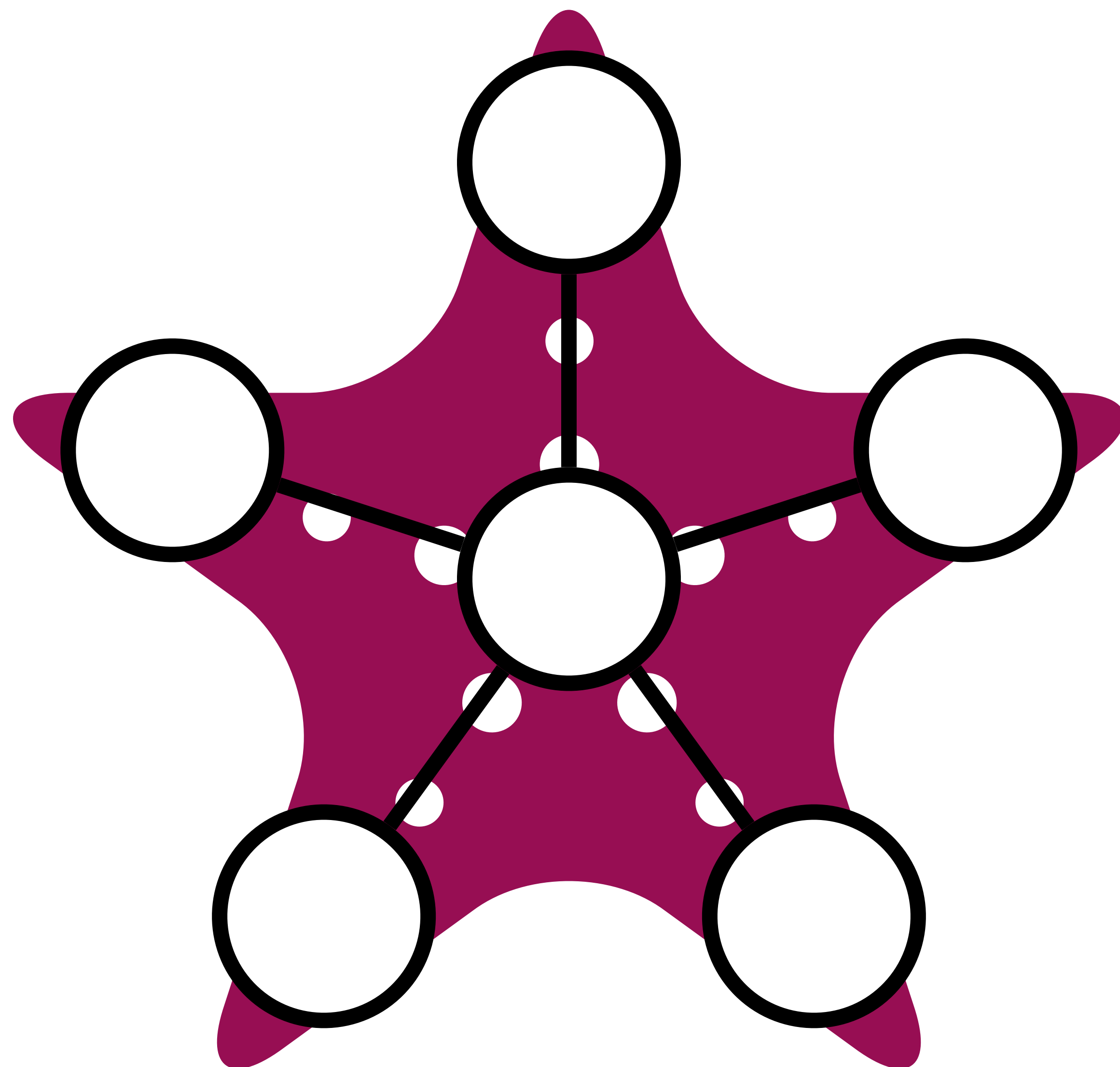
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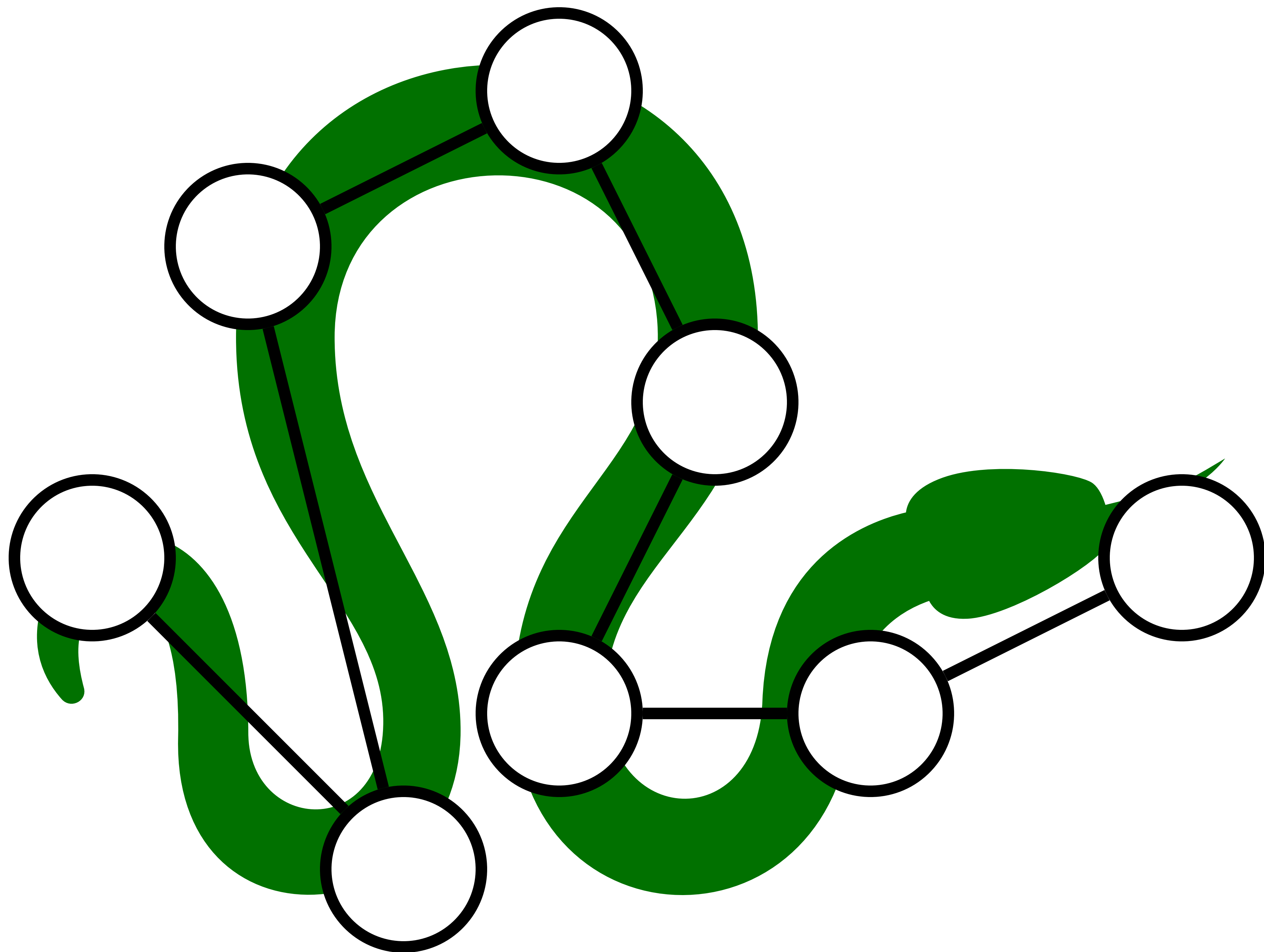
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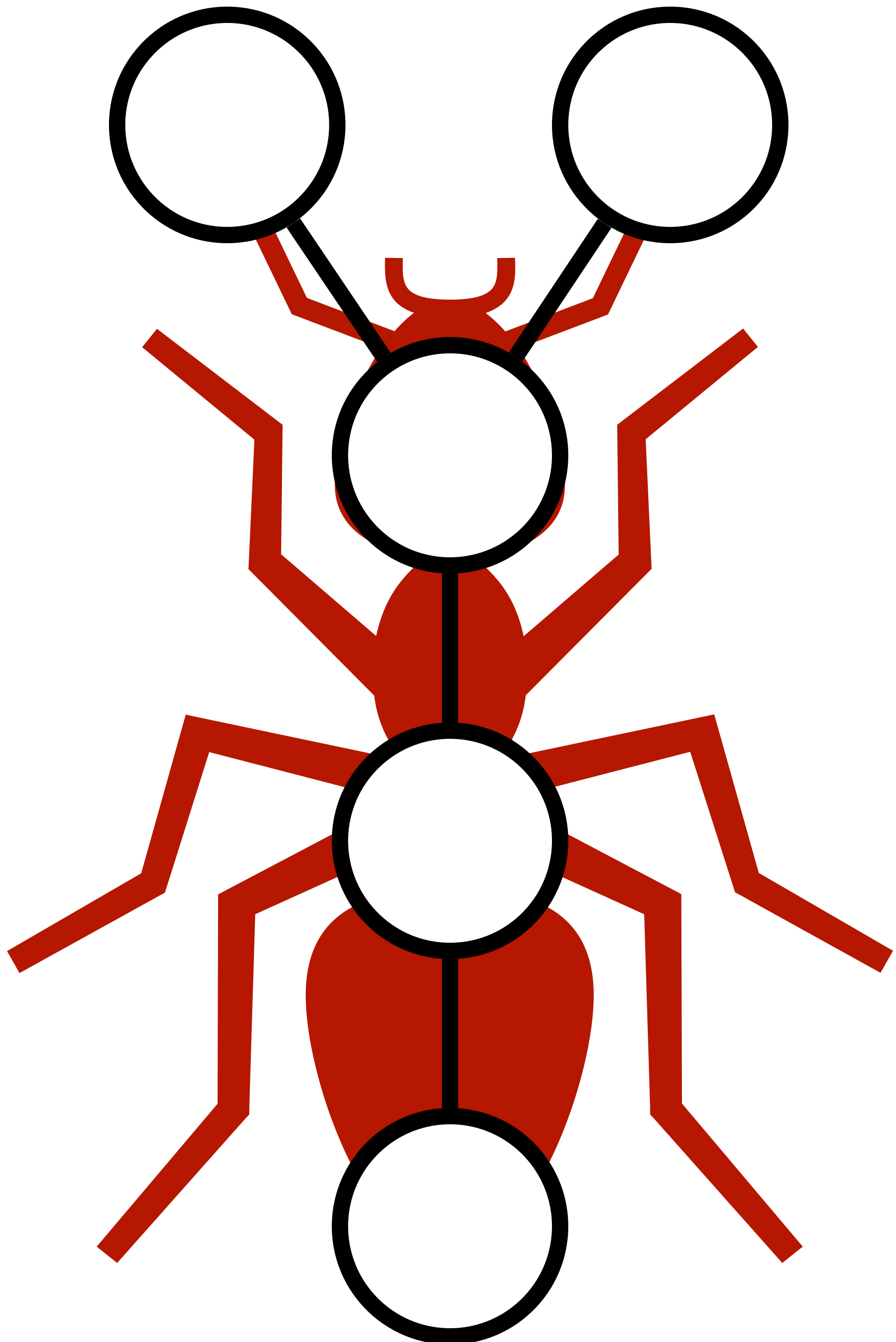
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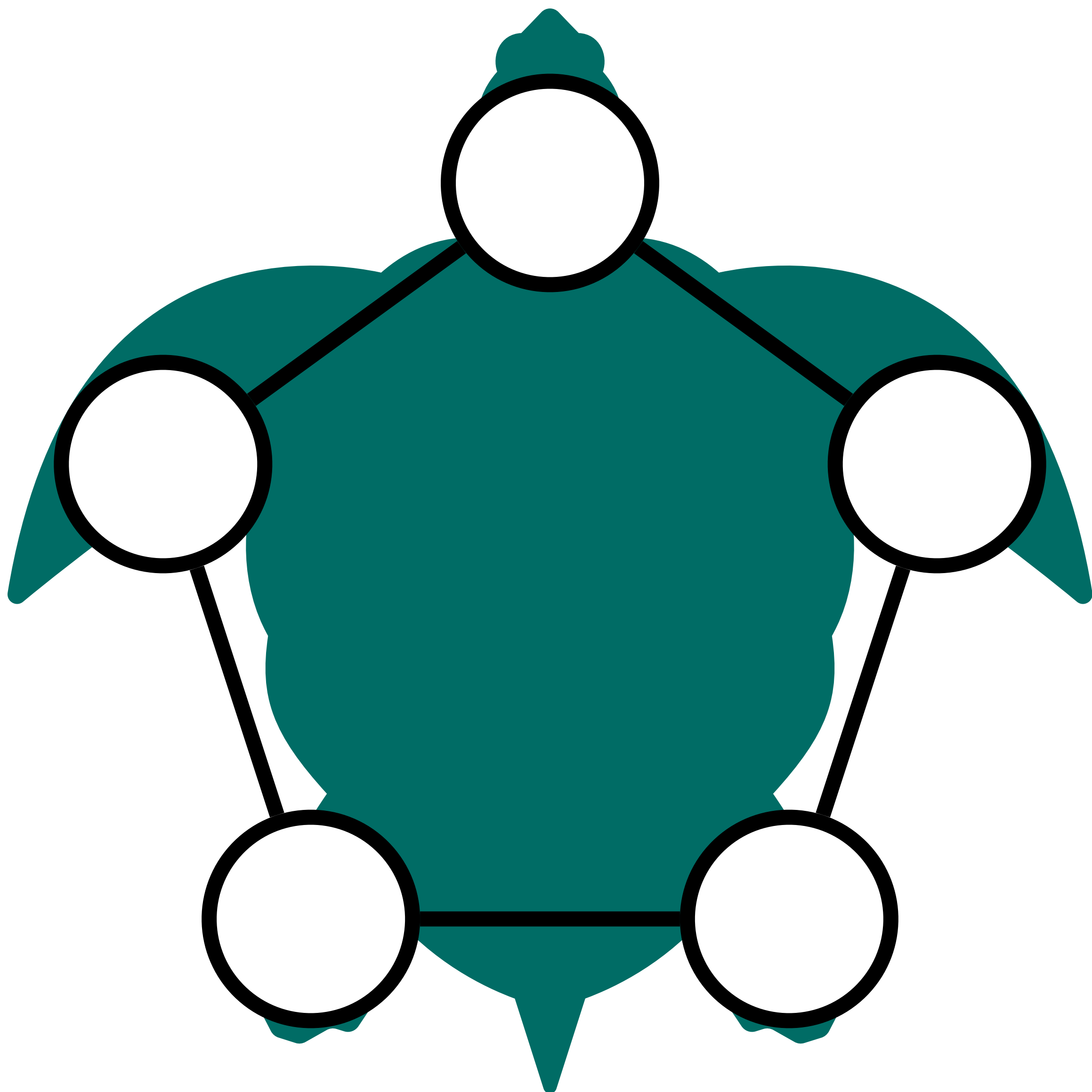
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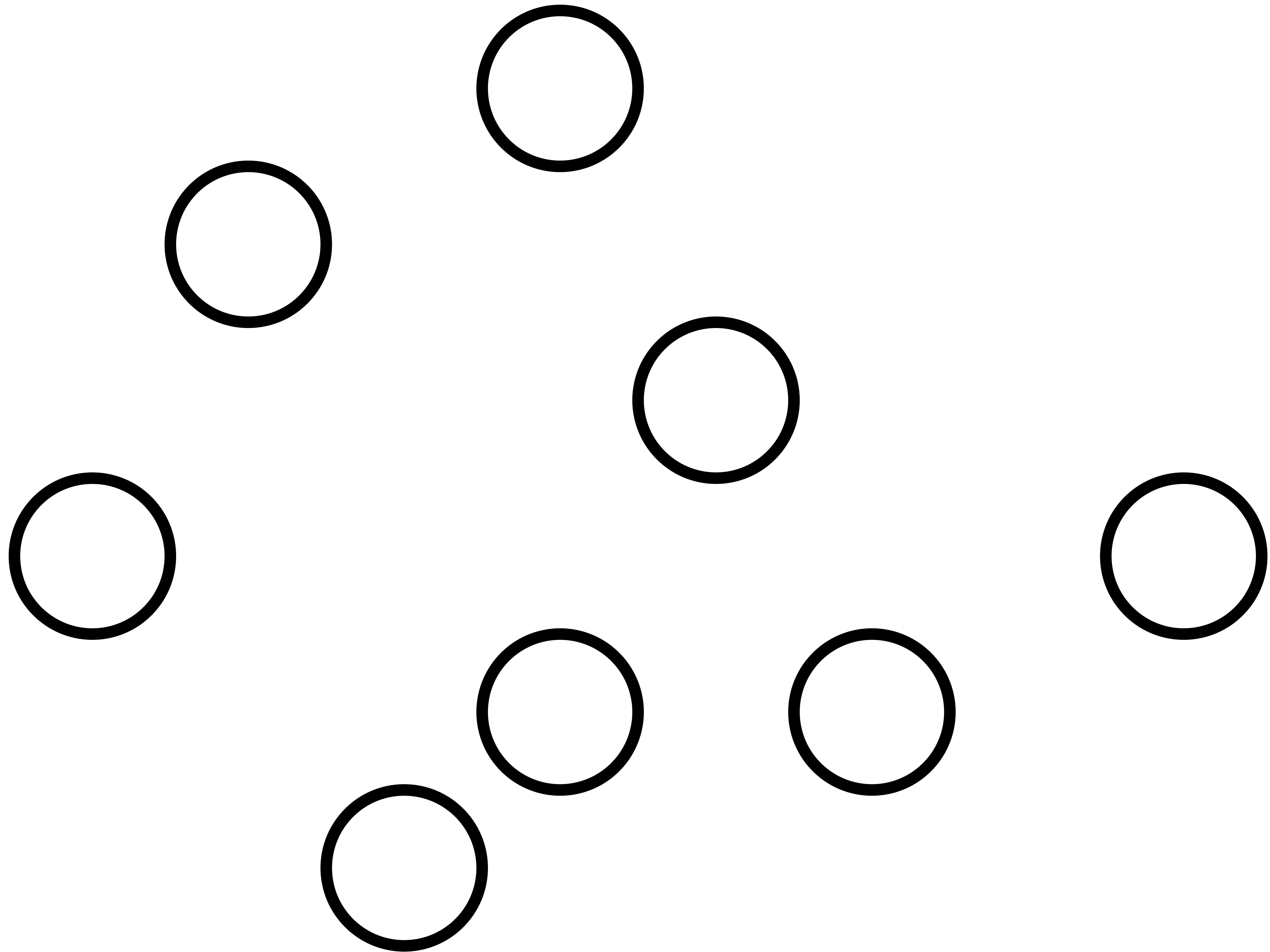
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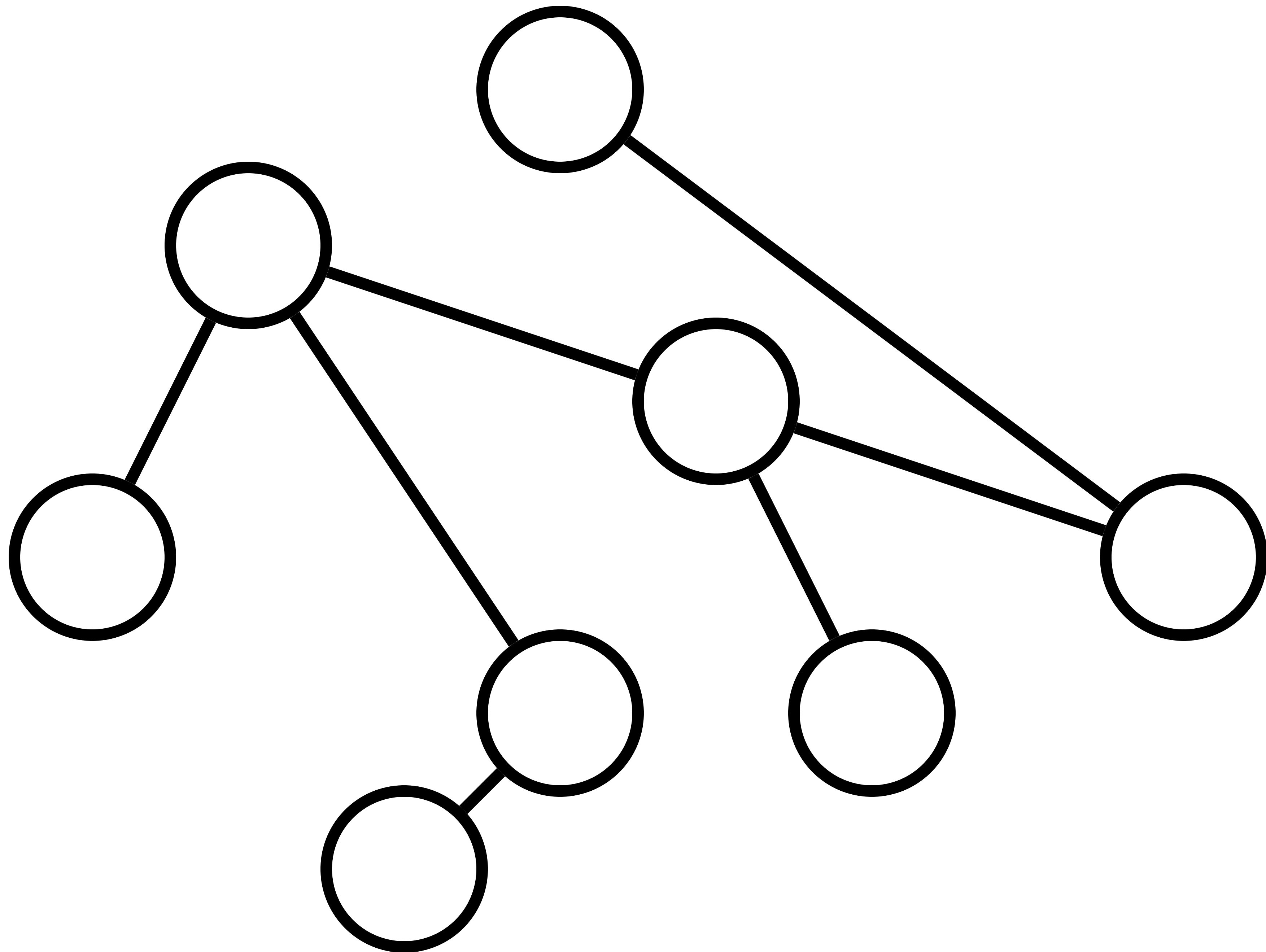
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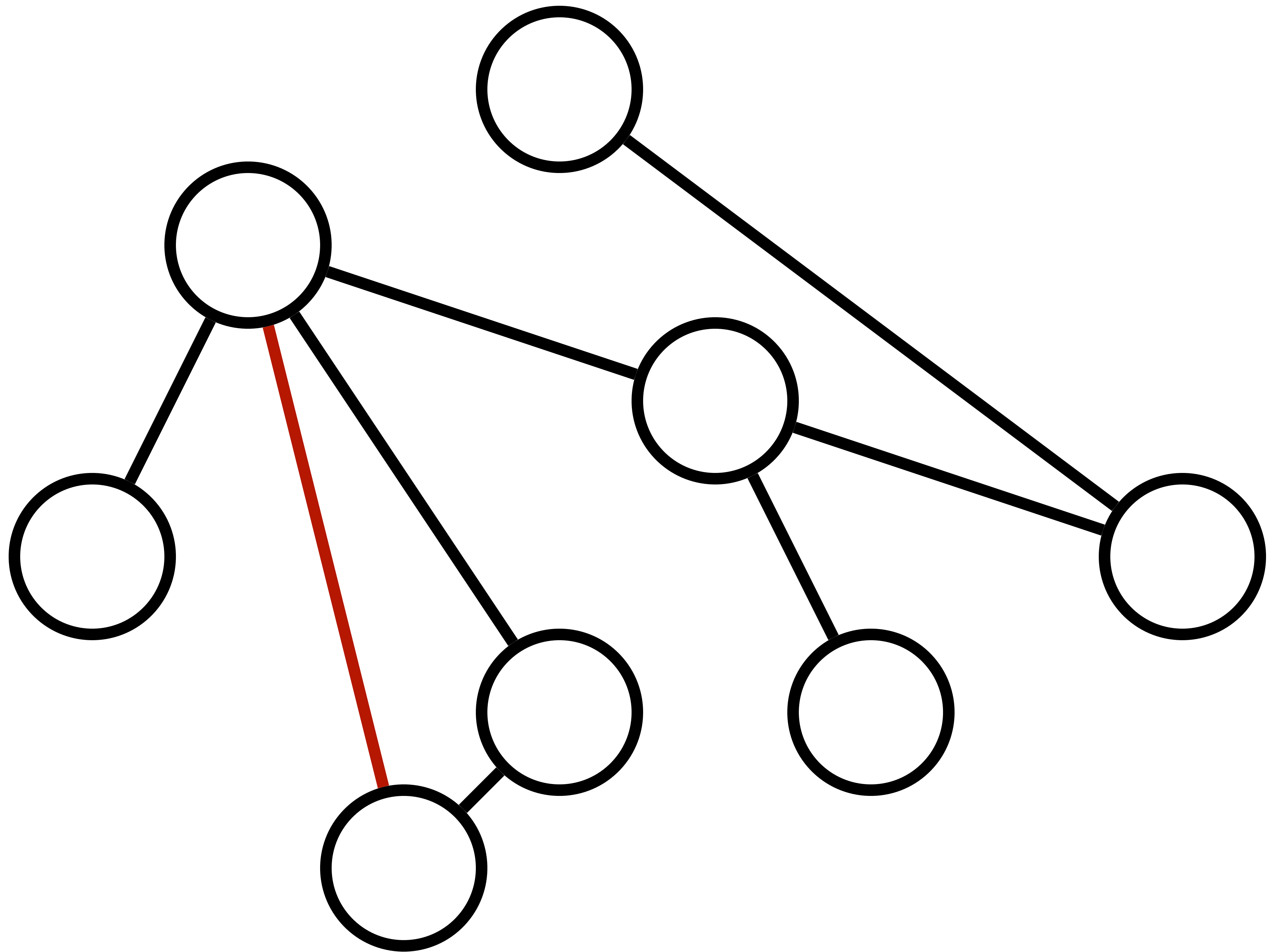
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accessible & extendable

“Imagine this problem is a room, and all students need to enter it through a doorway. If we want all our students to be able to succeed, we can ***lower the threshold*** in the doorway and the floor in the room so students have fewer barriers to get inside and get started.

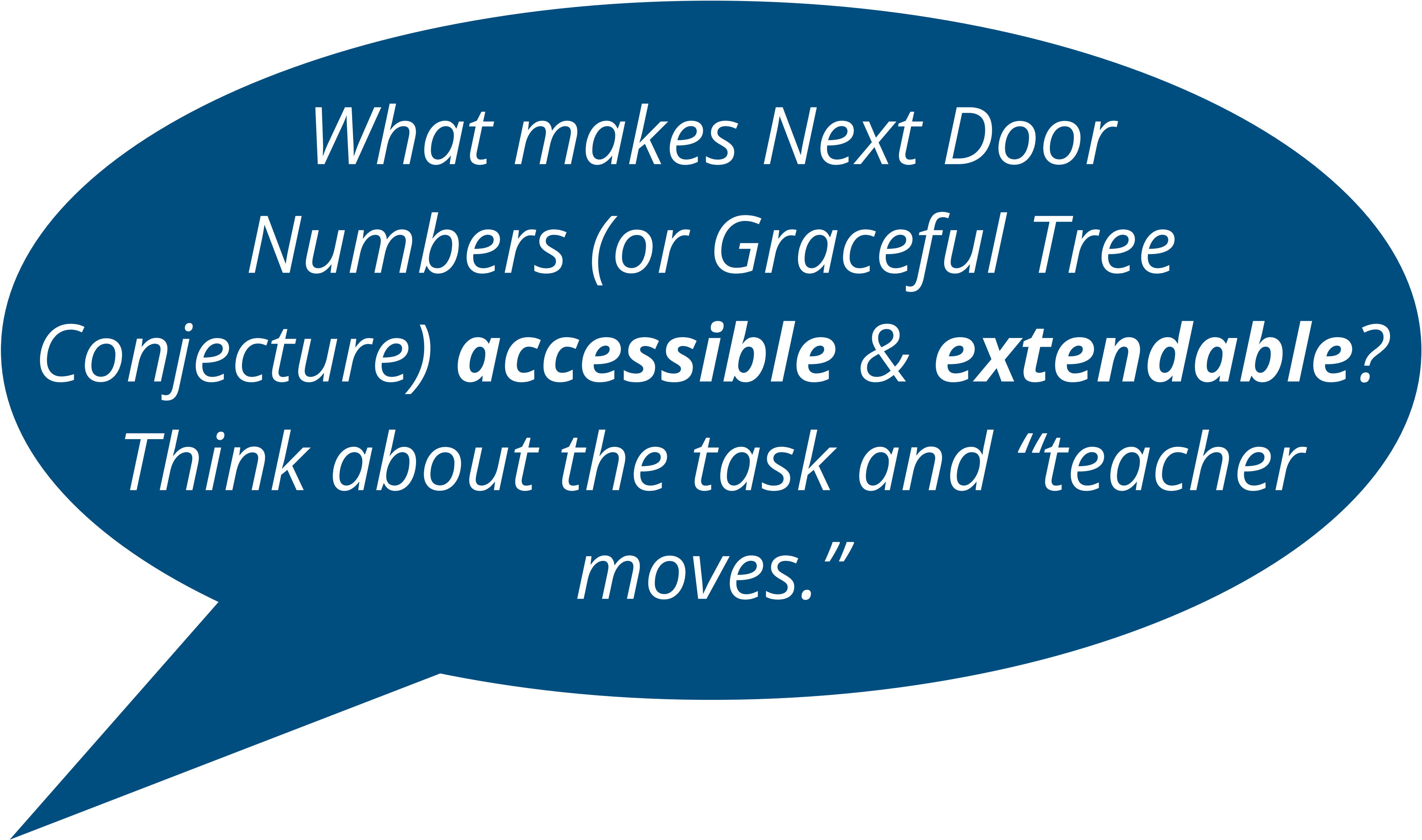
Zager, T. (2017). *Becoming the math teacher you wish you'd had: Ideas and strategies from vibrant classrooms*. Stenhouse.

We also want to make sure the students in the room are not constrained, banging their heads, unable to stretch. We want to ***raise the ceiling*** so there are fewer limits on students' thinking. We want to create problems that will flow right into deeper investigations for students who are ready."

Zager, T. (2017). *Becoming the math teacher you wish you'd had: Ideas and strategies from vibrant classrooms*. Stenhouse.

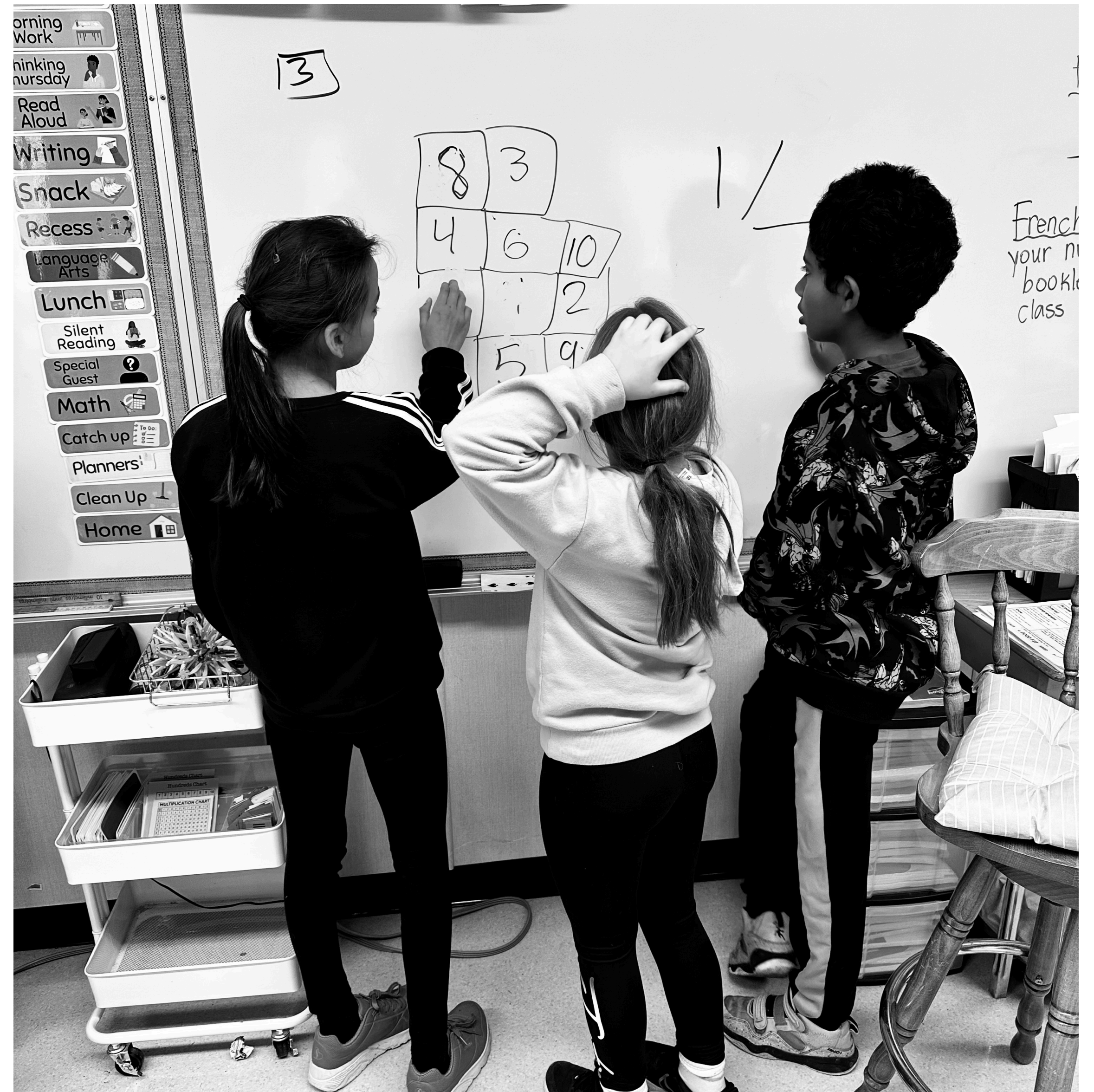
Everyone can get **started**.

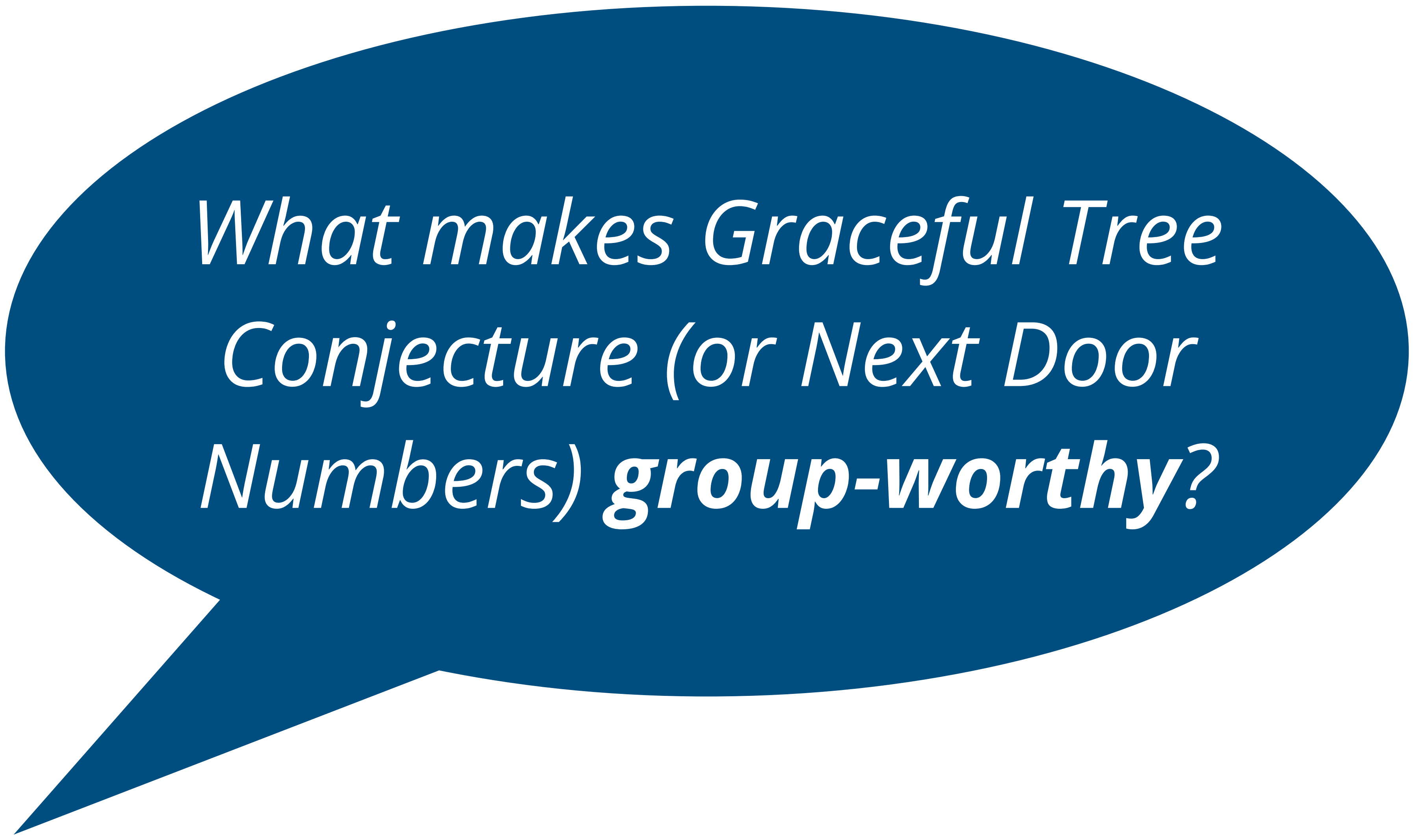
Everyone can get **stuck**.



*What makes Next Door
Numbers (or Graceful Tree
Conjecture) **accessible & extendable?**
Think about the task and “teacher
moves.”*

invites collaboration





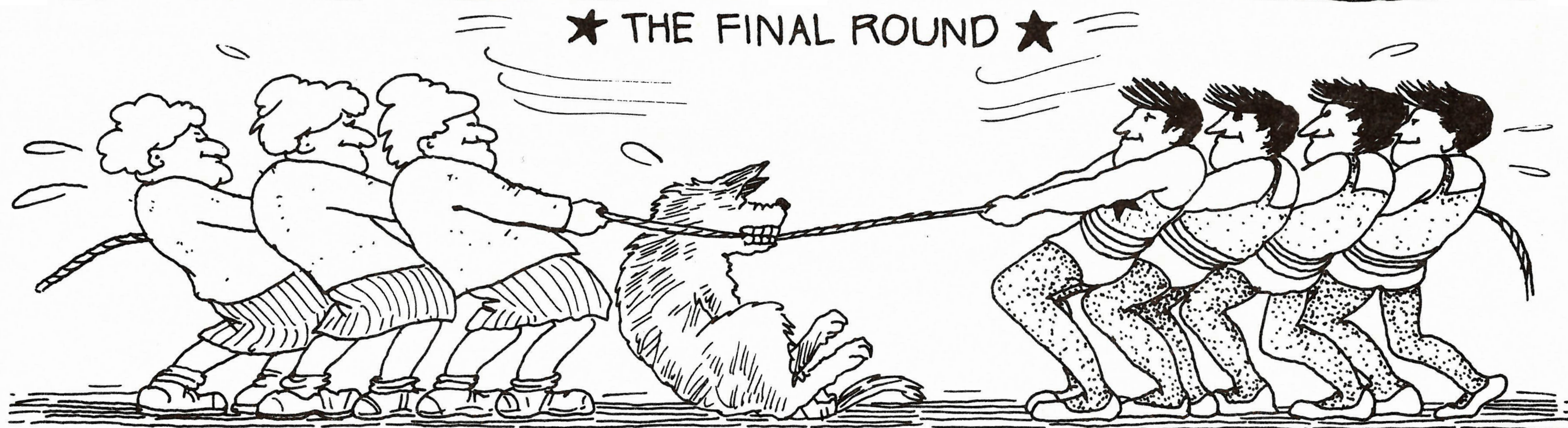
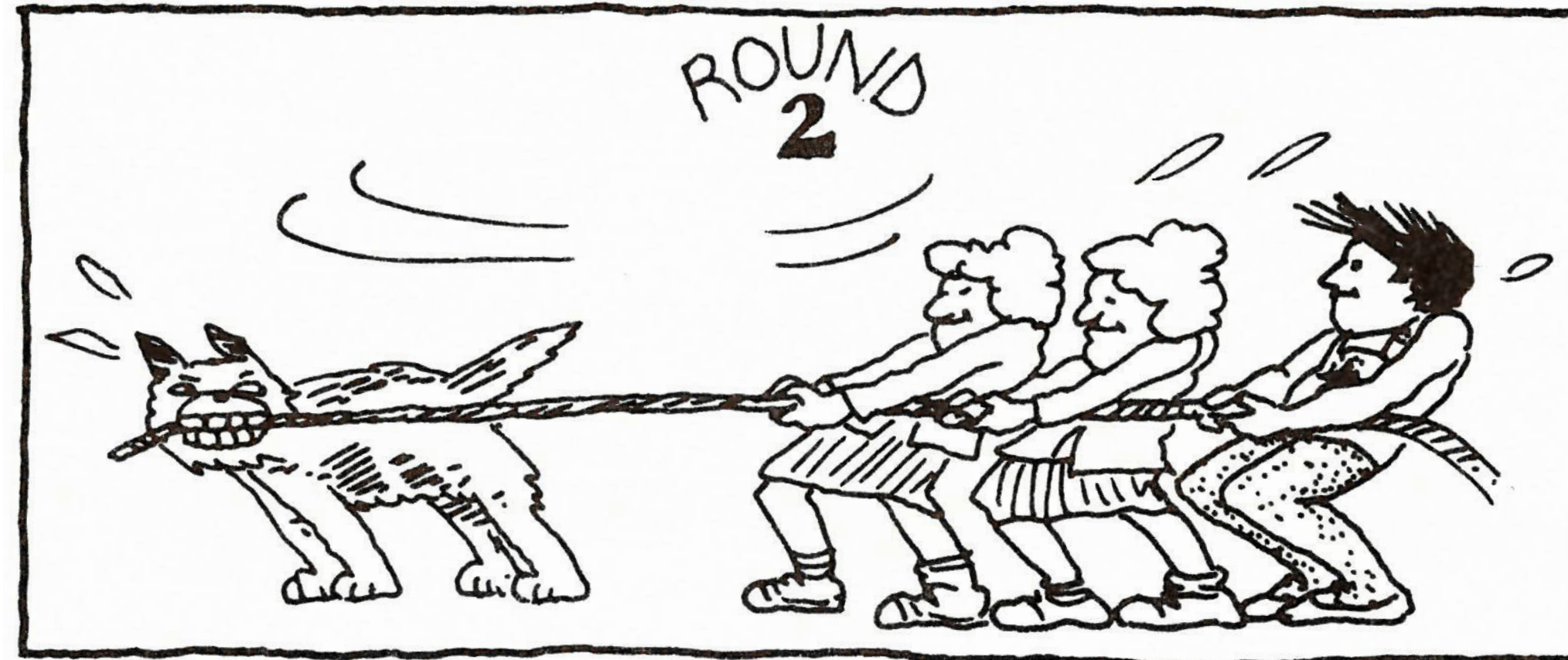
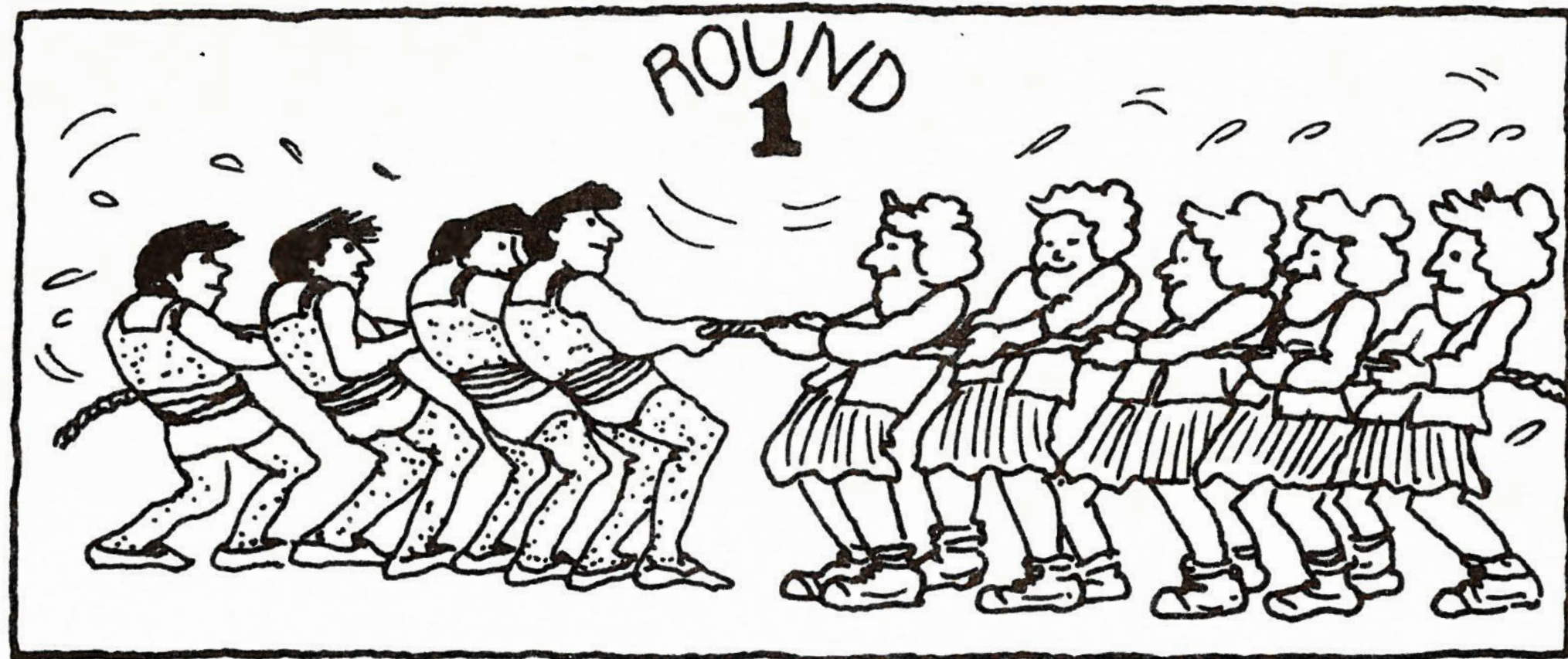
*What makes Graceful Tree
Conjecture (or Next Door
Numbers) **group-worthy**?*

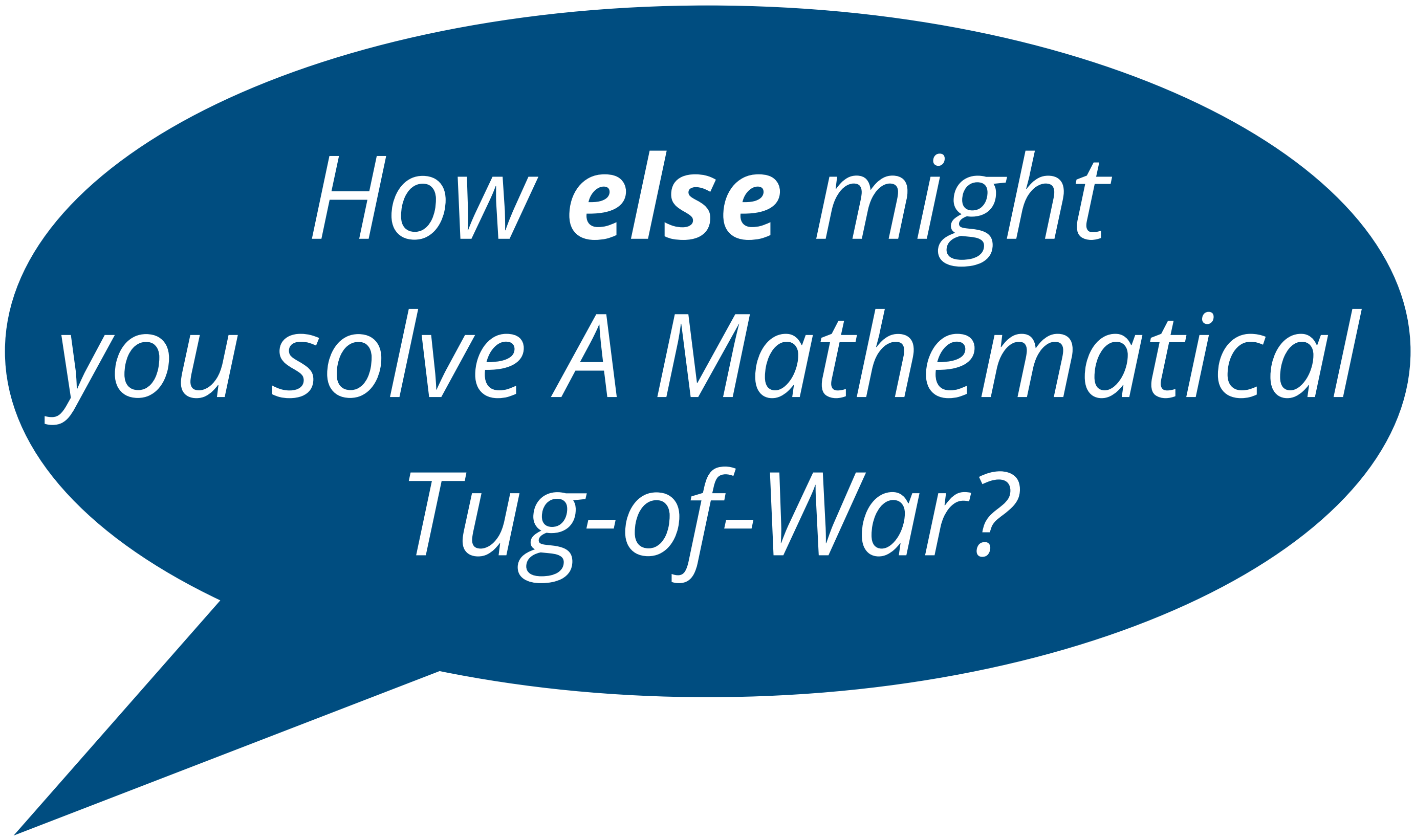
- accessible
- extendable
- invites collaboration

44

A Mathematical Tug-of-War

Burns, M. (1982). *Math for smarty pants*. Little, Brown.





*How **else** might
you solve A Mathematical
Tug-of-War?*

different strategies

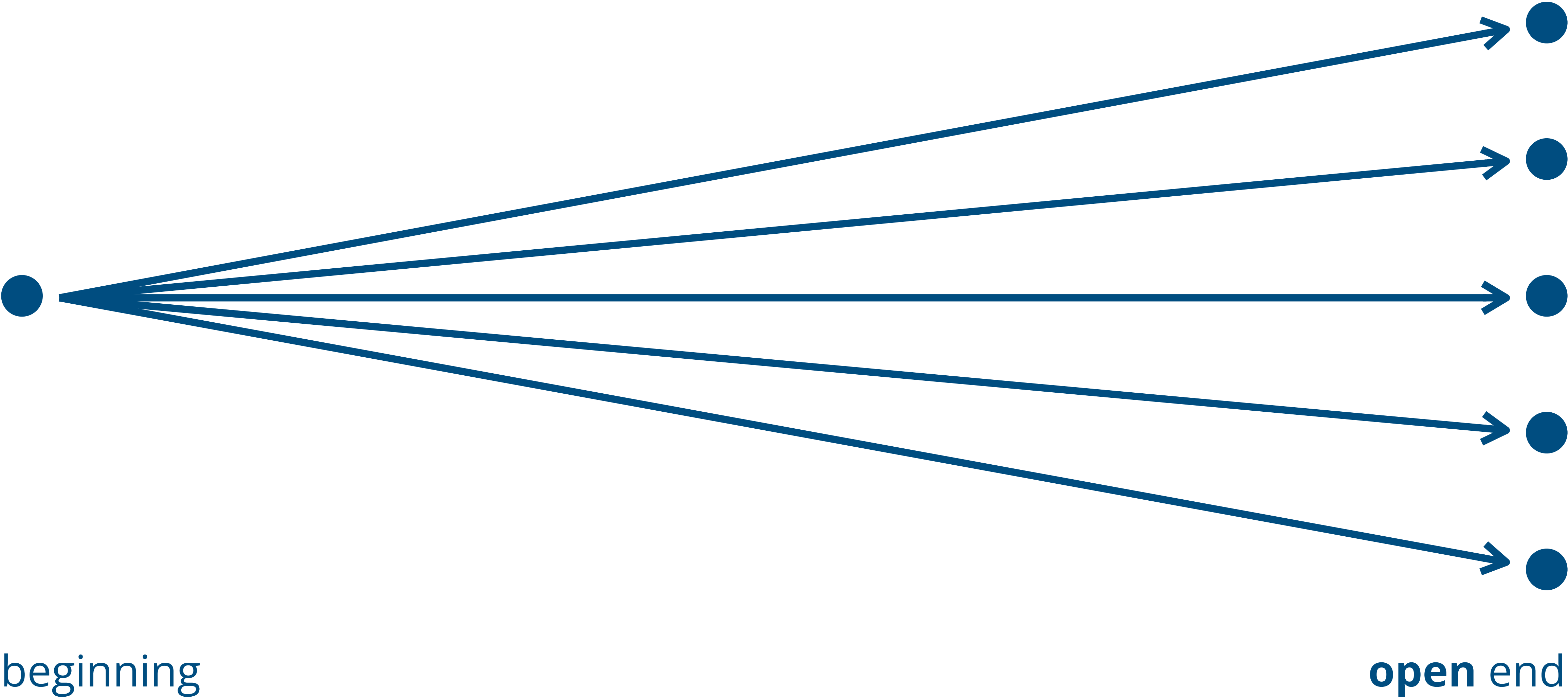
Meyer, D. (2014). Video games and making math more like things students like. [Video]



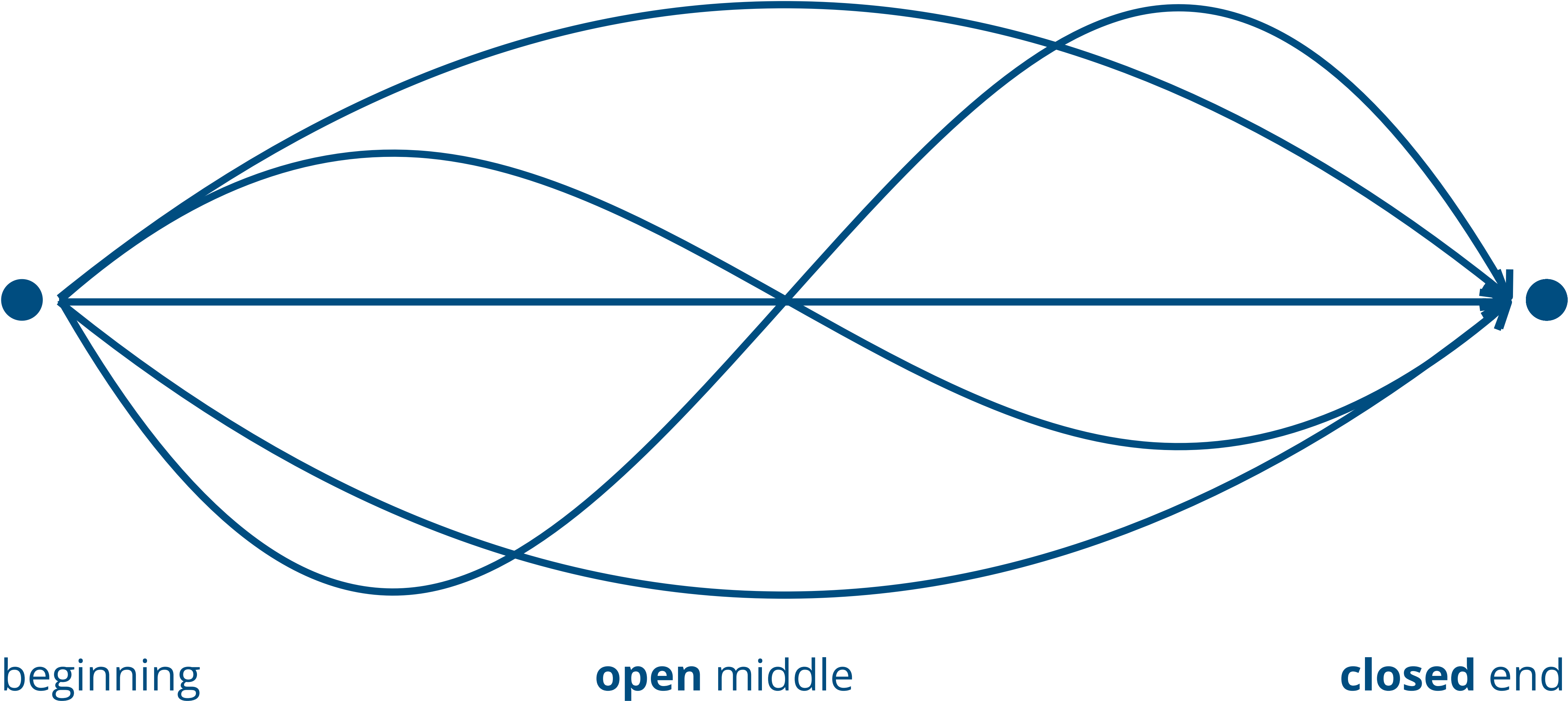
beginning

closed end

[Meyer, D. \(2014\). Video games and making math more like things students like. \[Video\]](#)



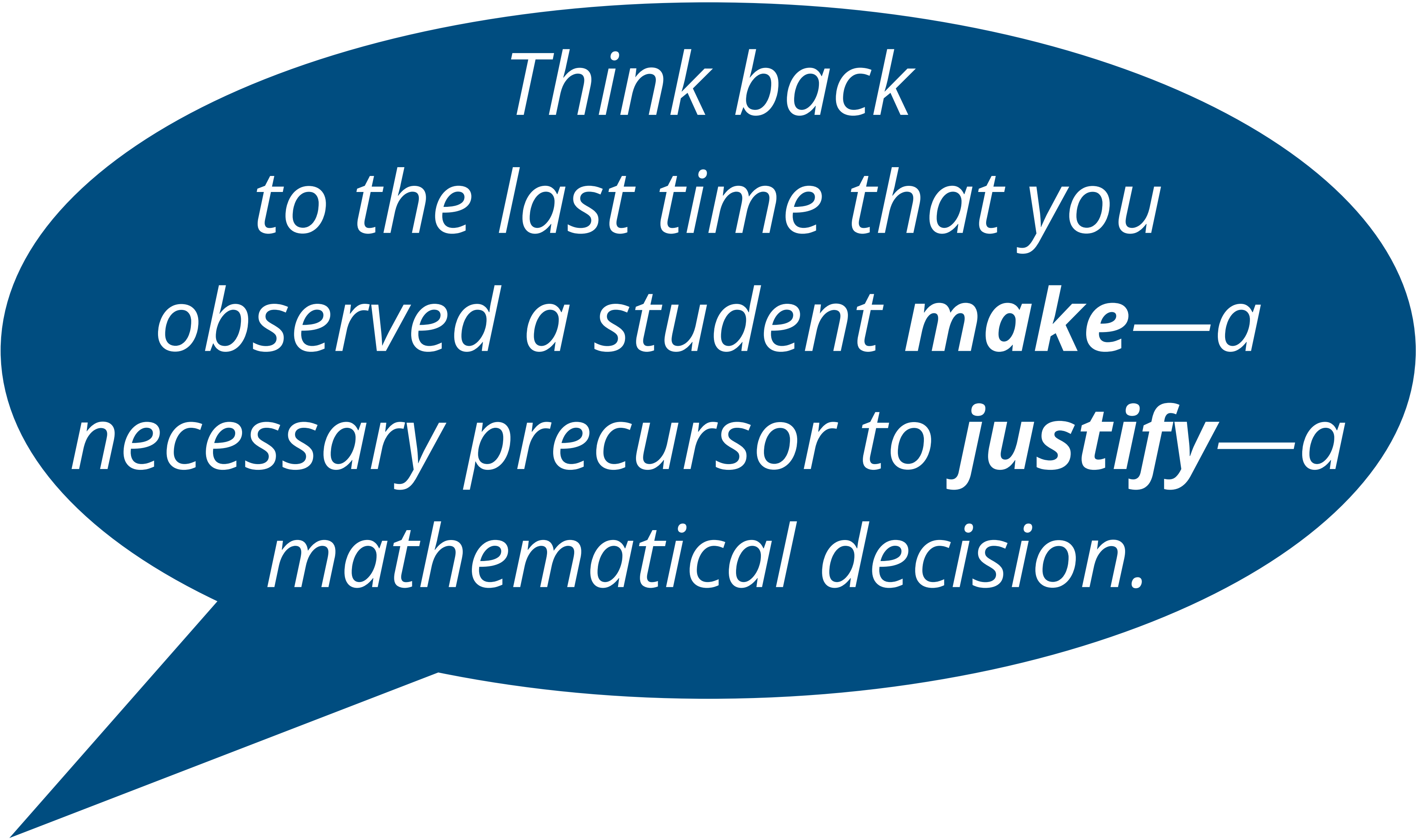
Meyer, D. (2014). Video games and making math more like things students like. [Video]



explain ideas & justify decisions

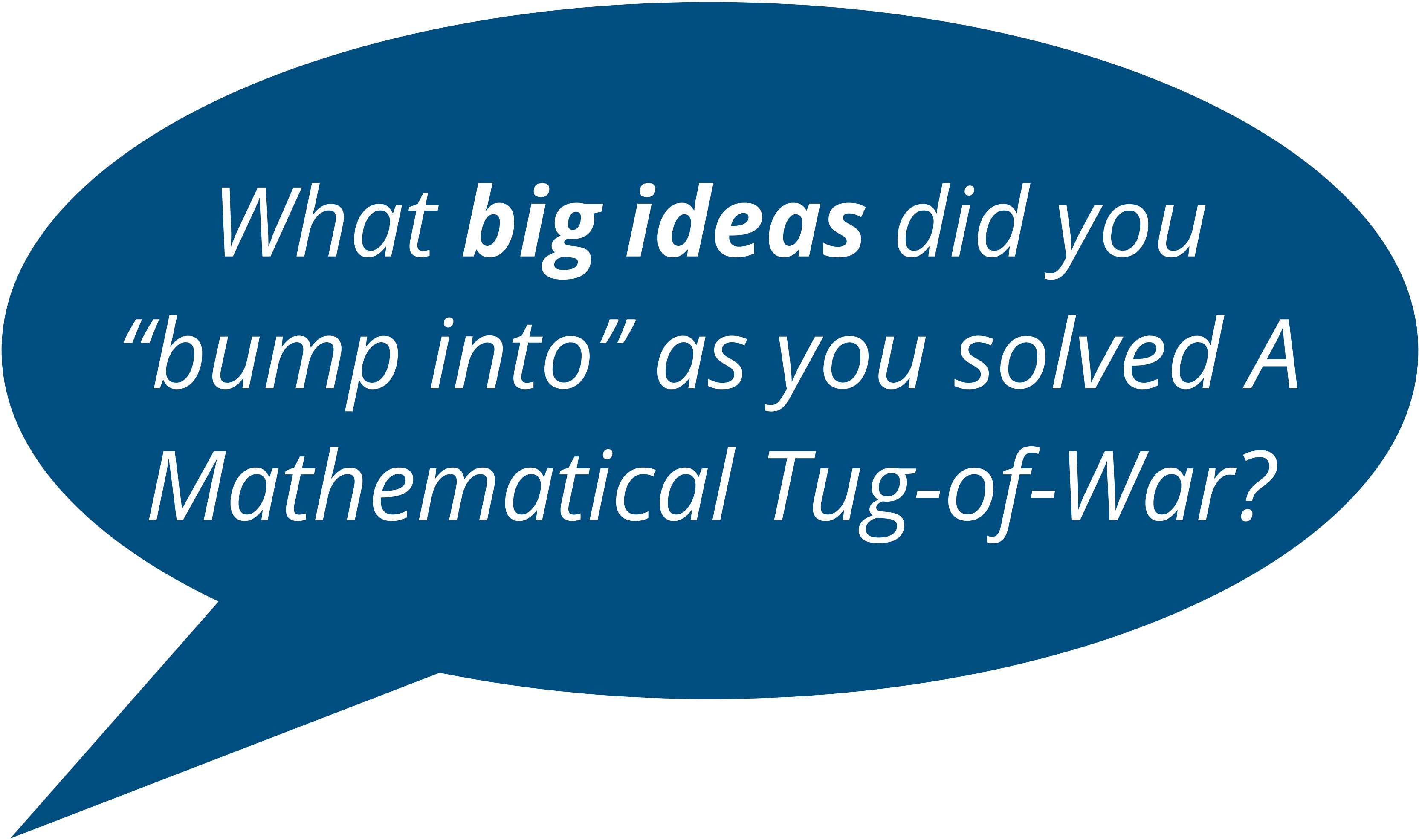
Q: Who will win the third round?

A: Ivan and three of the grandmas.

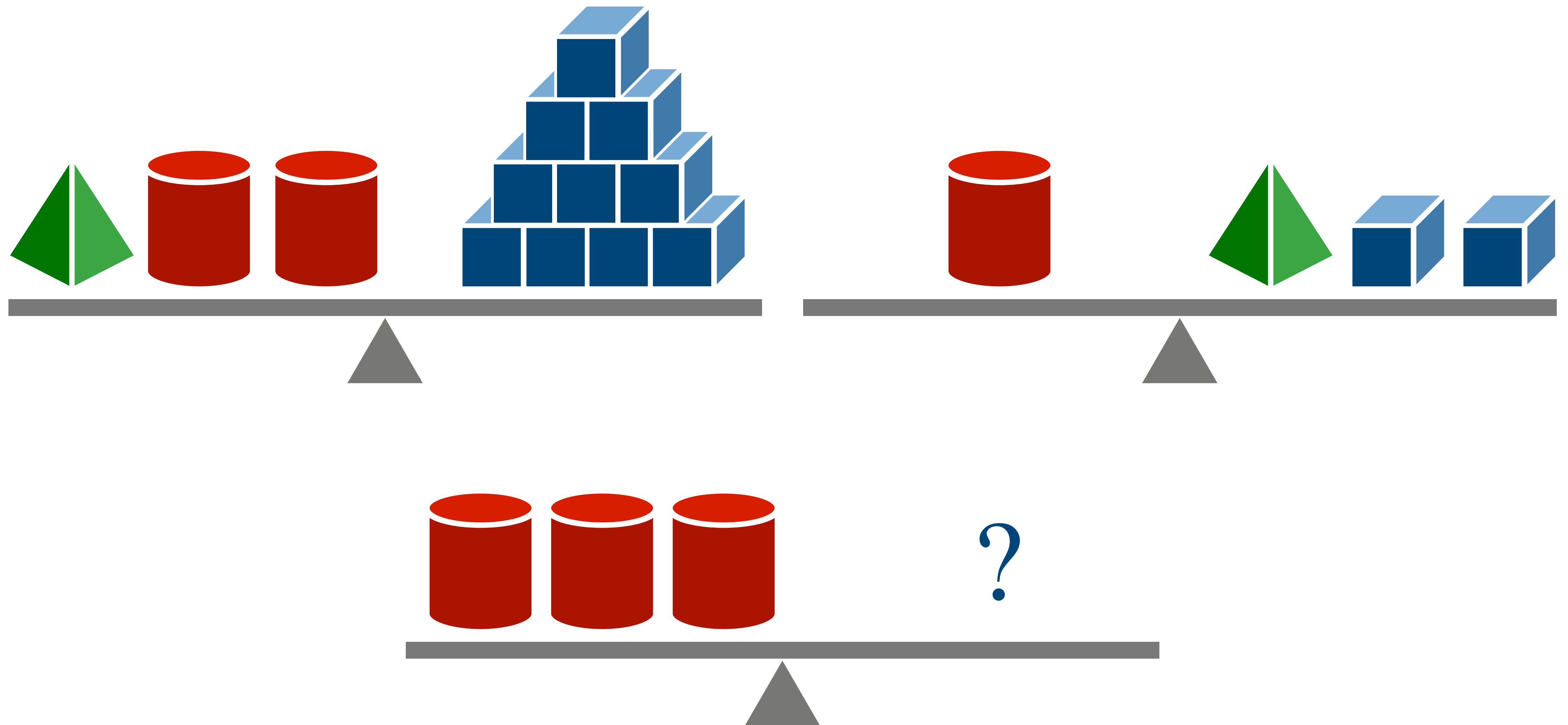


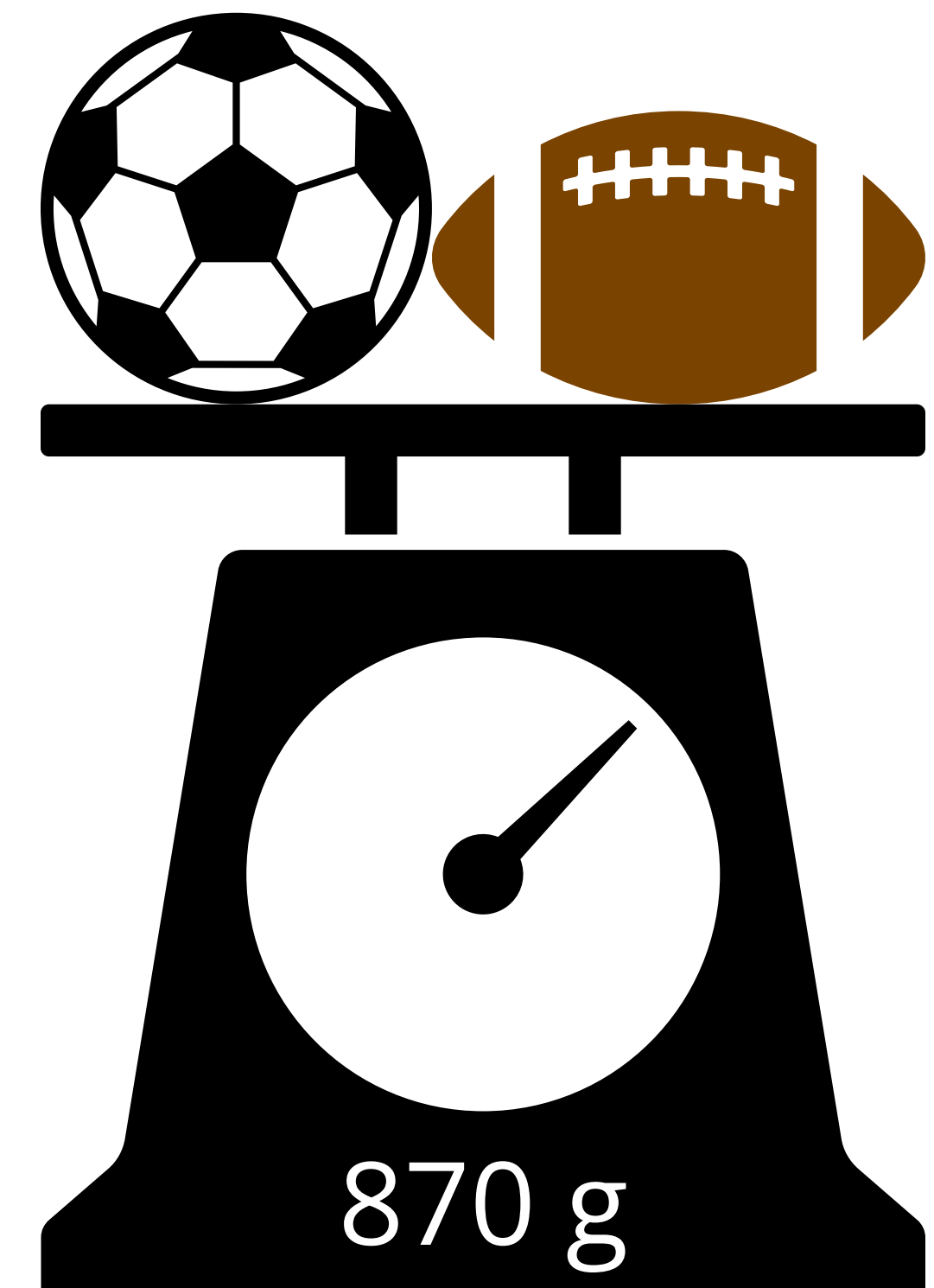
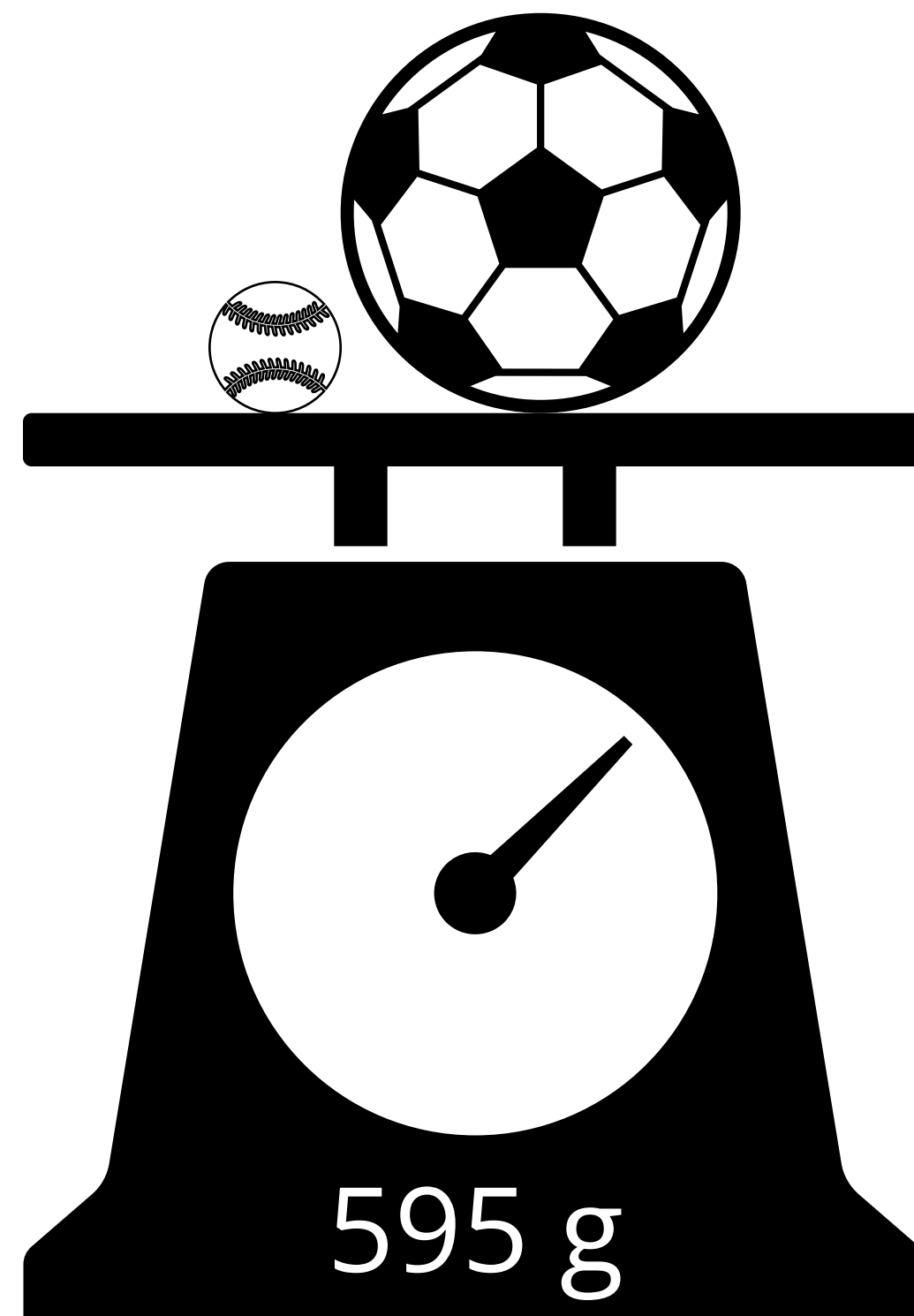
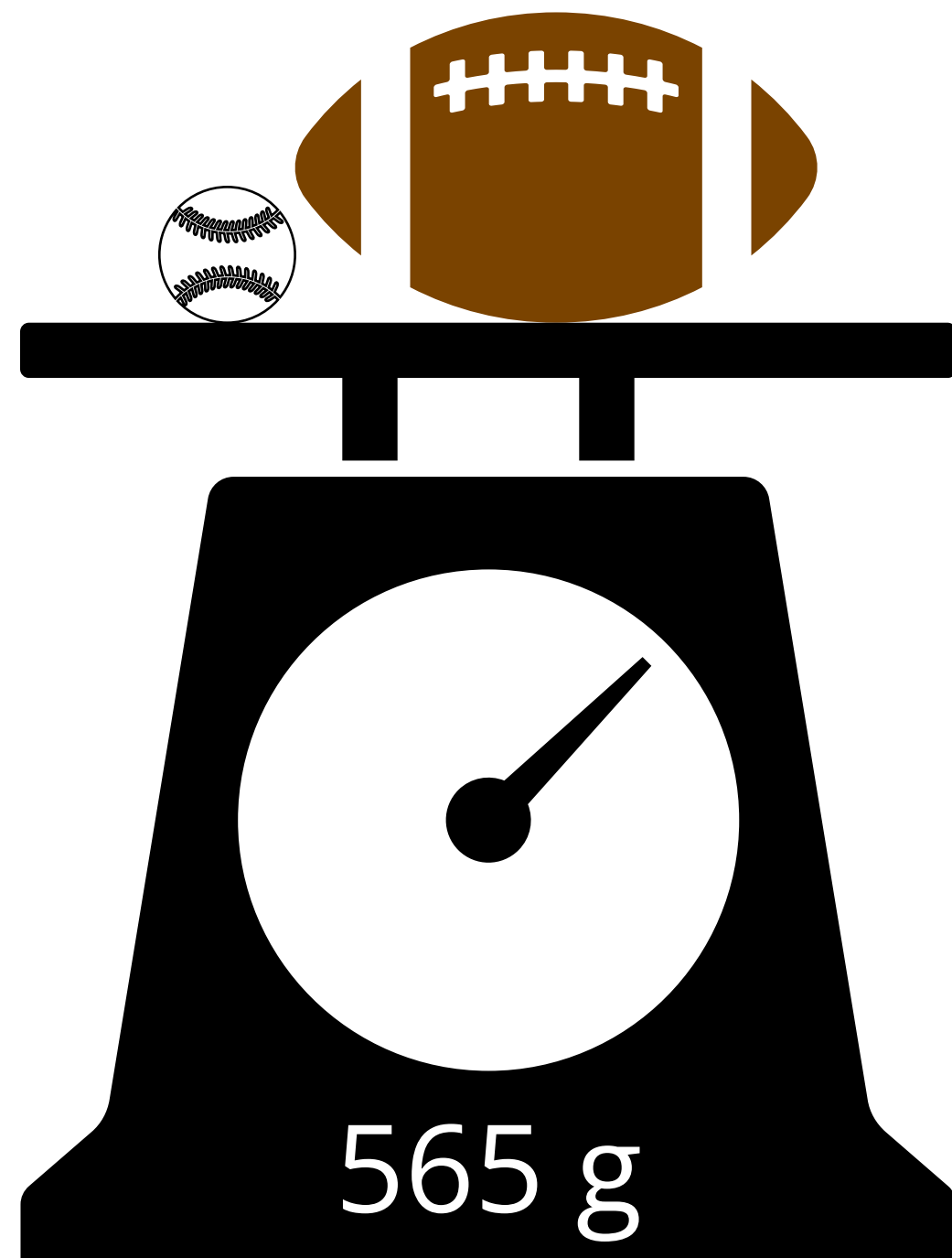
*Think back
to the last time that you
observed a student **make**—a
necessary precursor to **justify**—a
mathematical decision.*

essential understandings



*What **big ideas** did you
“bump into” as you solved A
Mathematical Tug-of-War?*





Van de Walle, J. A., Bay-Williams, J. M., Karp, K. S. & McGarvey, L. M. (2017). *Elementary and middle school mathematics: Teaching developmentally*, 5th Canadian edition. Pearson.

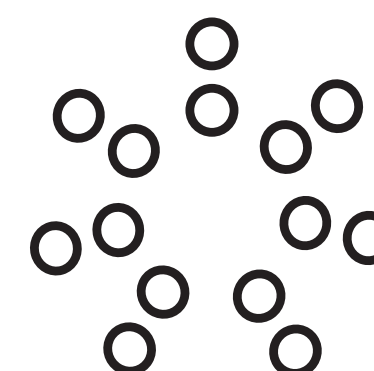
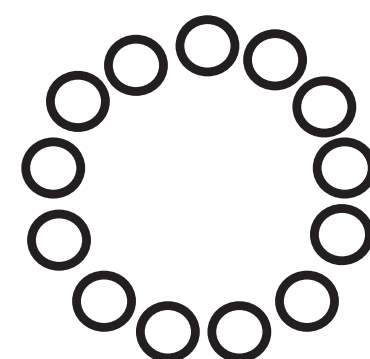
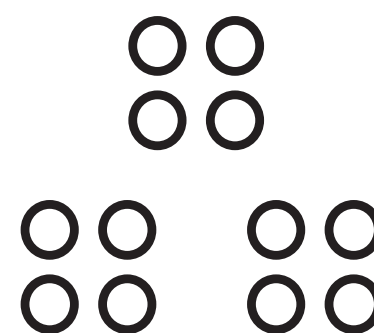
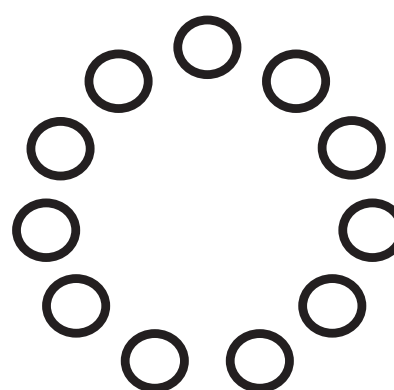
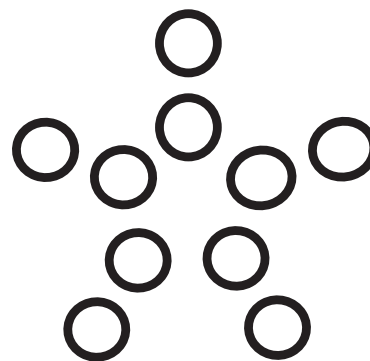
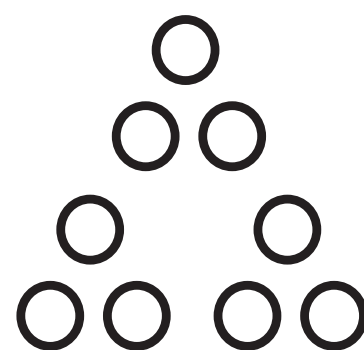
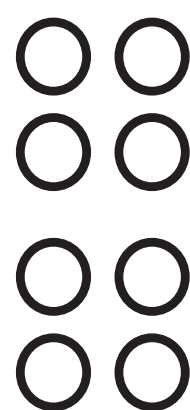
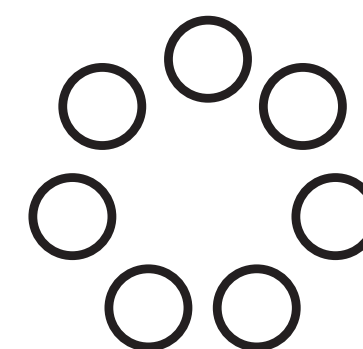
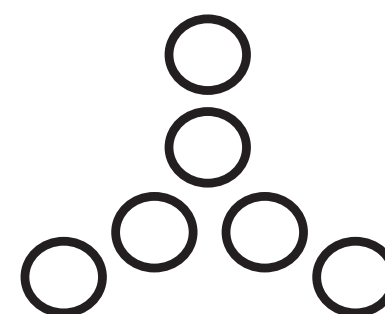
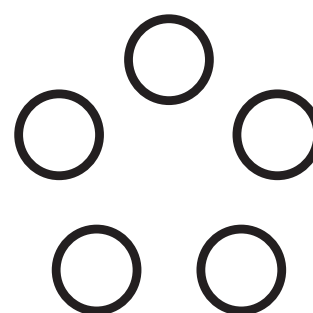
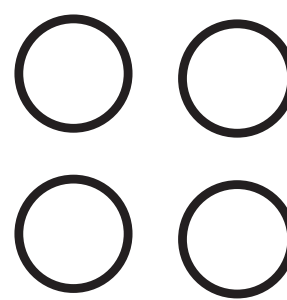
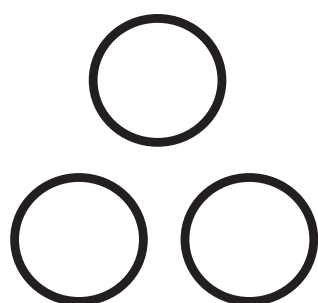
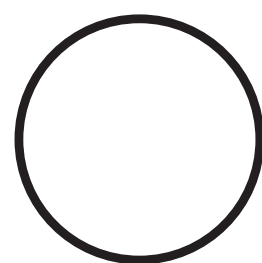
- accessible
- extendable
- invites collaboration

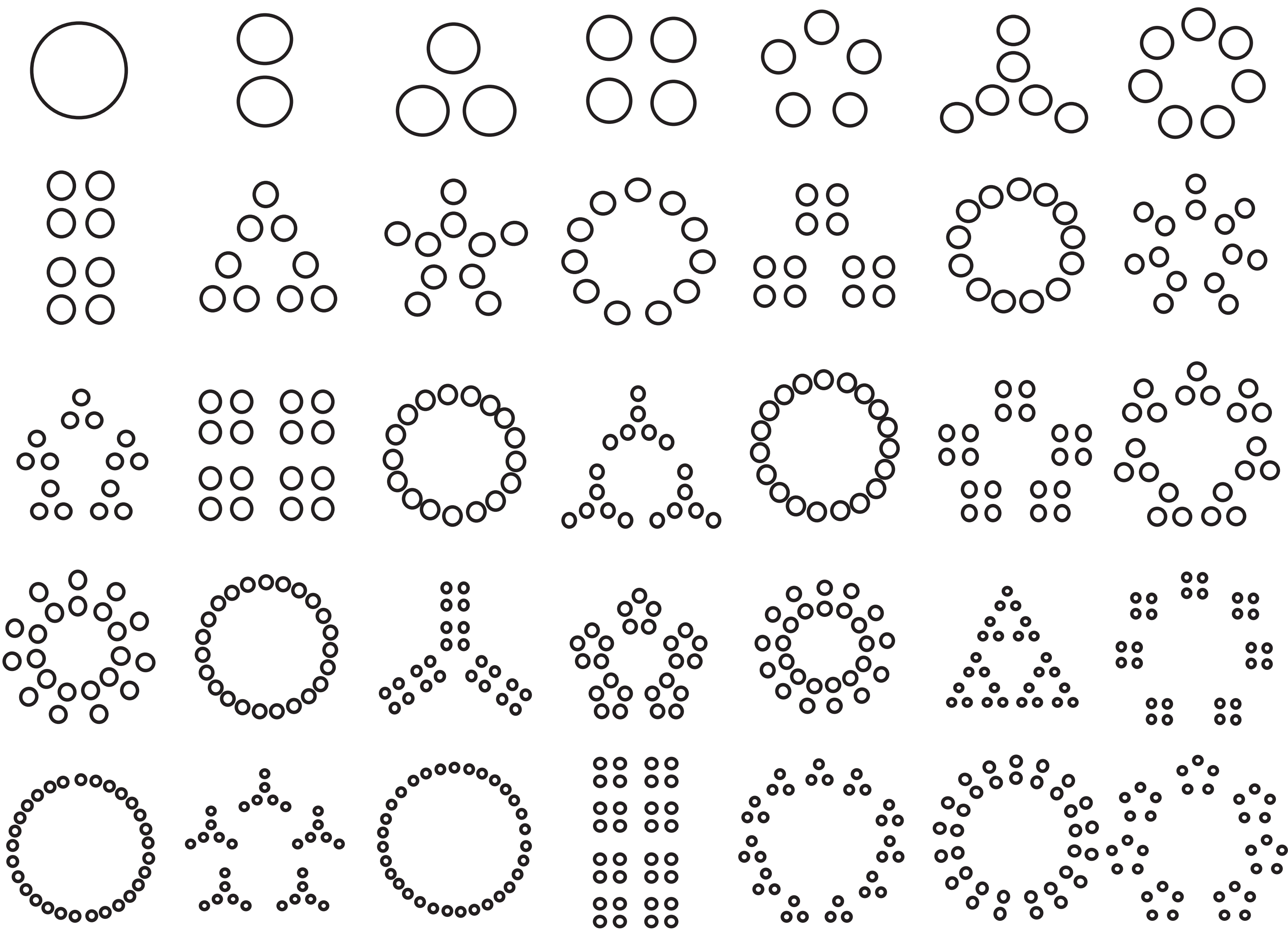
- accessible
- extendable
- invites collaboration
- different strategies
- explain ideas & justify decisions
- essential understandings

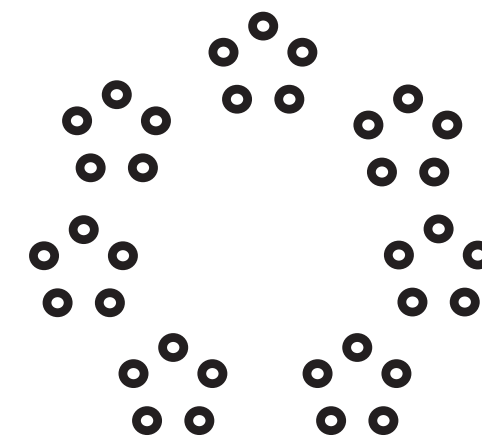
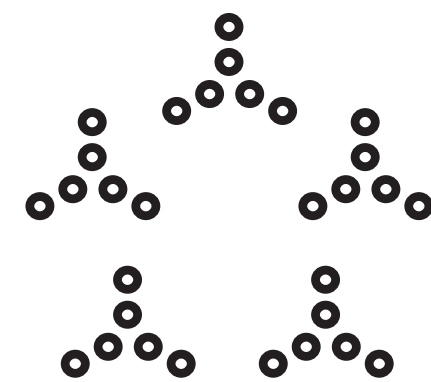
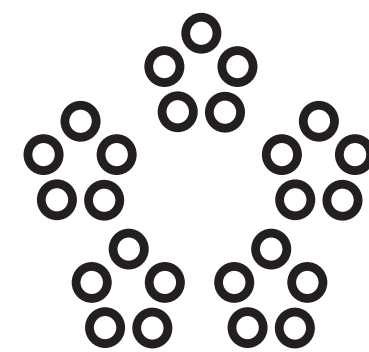
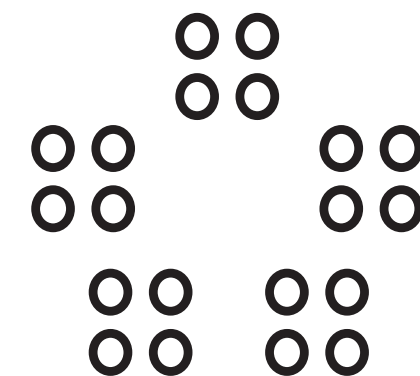
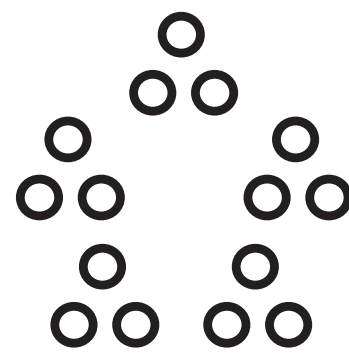
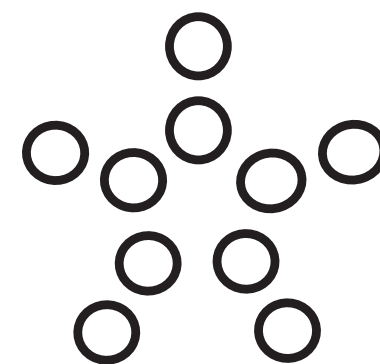
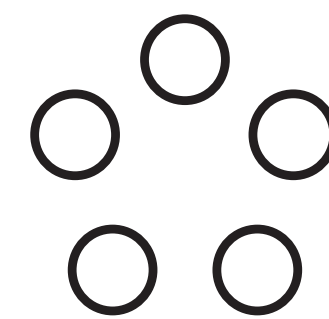
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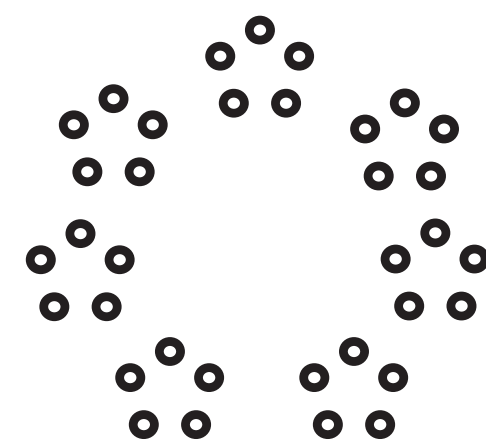
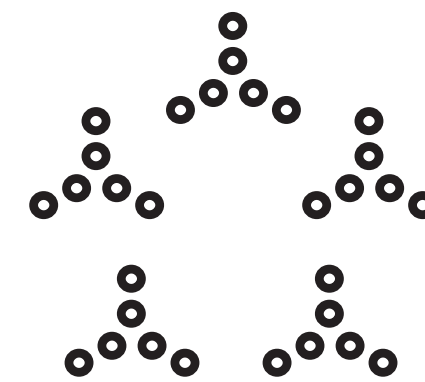
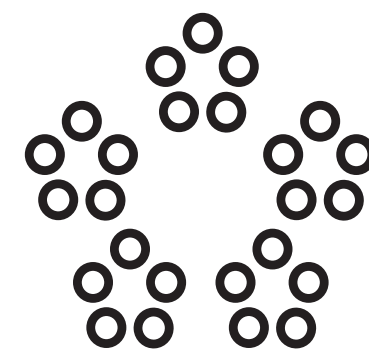
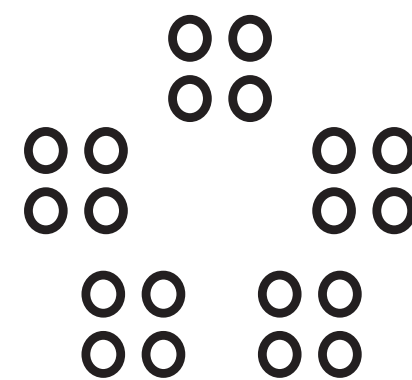
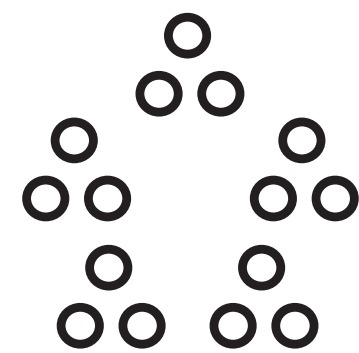
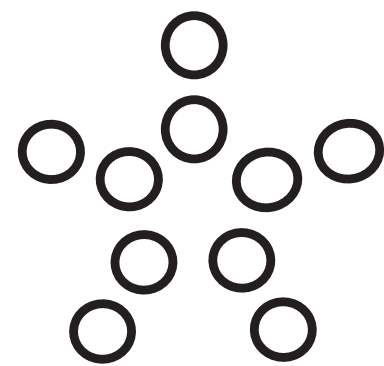
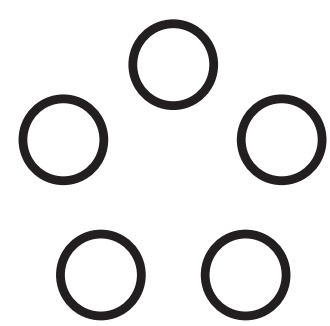
Number Visuals

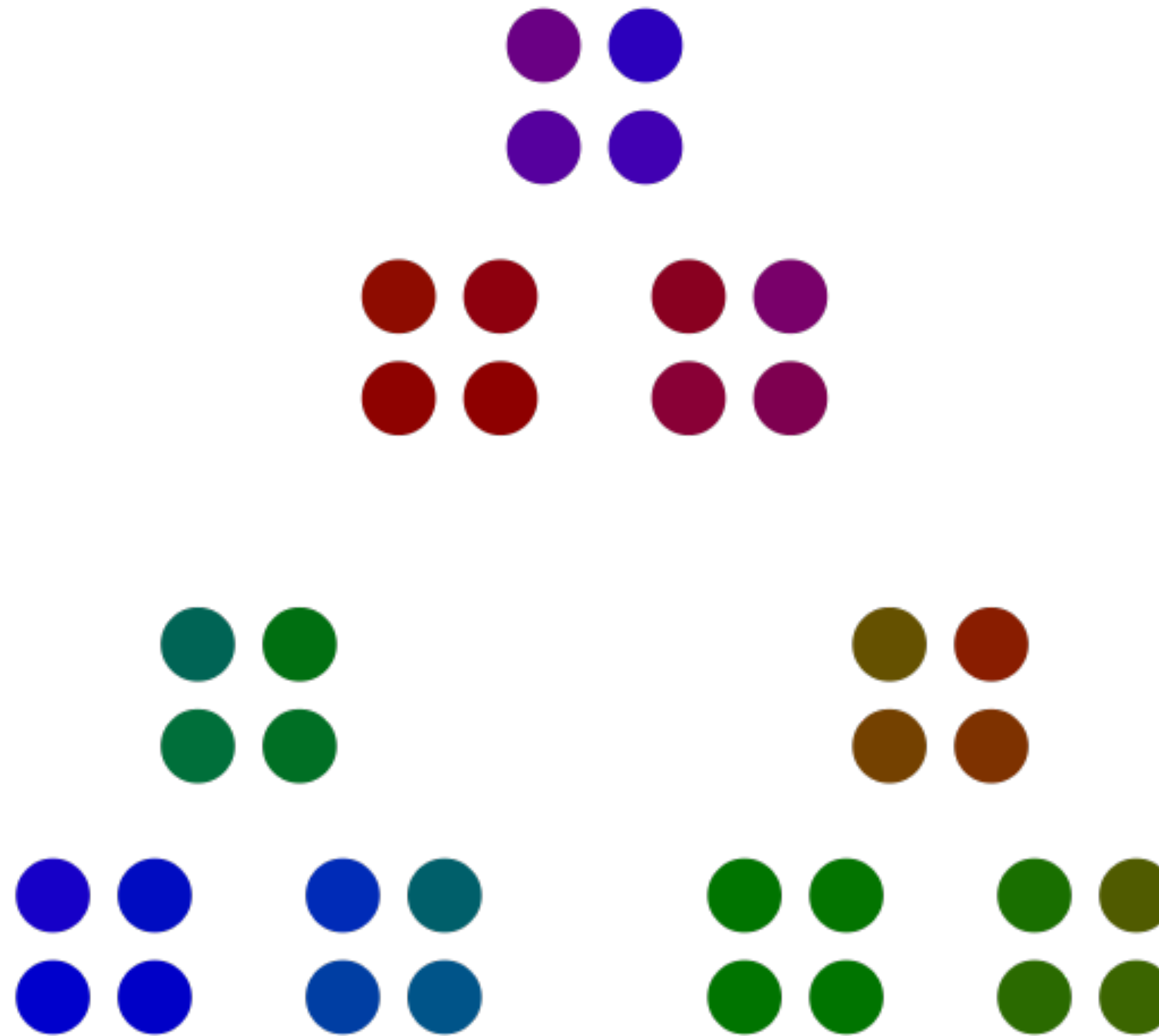
Number visuals. youcubed. <https://www.youcubed.org/resources/number-visuals-k-12/>











$$36 = 3 \times 3 \times 2 \times 2$$

**what
repeats?**

pattern-seeking & generalizing

“Trying to articulate a sense of some underlying pattern is called **generalizing**. It means noticing certain features common to several particular examples and ignoring other features. Once articulated, the generalization turns into a conjecture which must then be investigated if it is accurate. This whole process is the **essence of mathematical thinking**.”

Mason, J., Burton, L. & Stacey, K. (2010). *Thinking Mathematically*, 2nd ed. Prentice Hall.

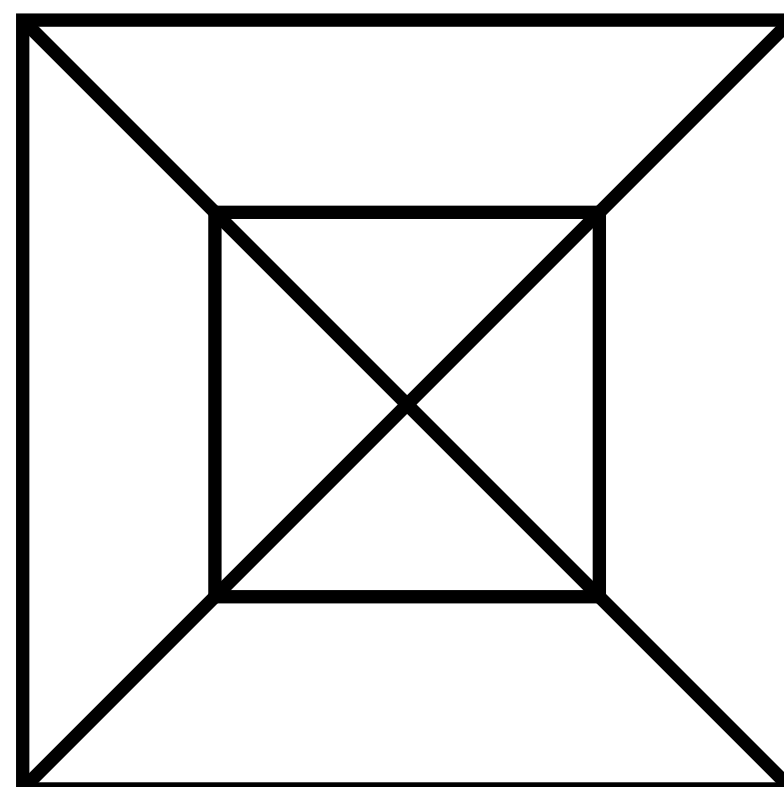
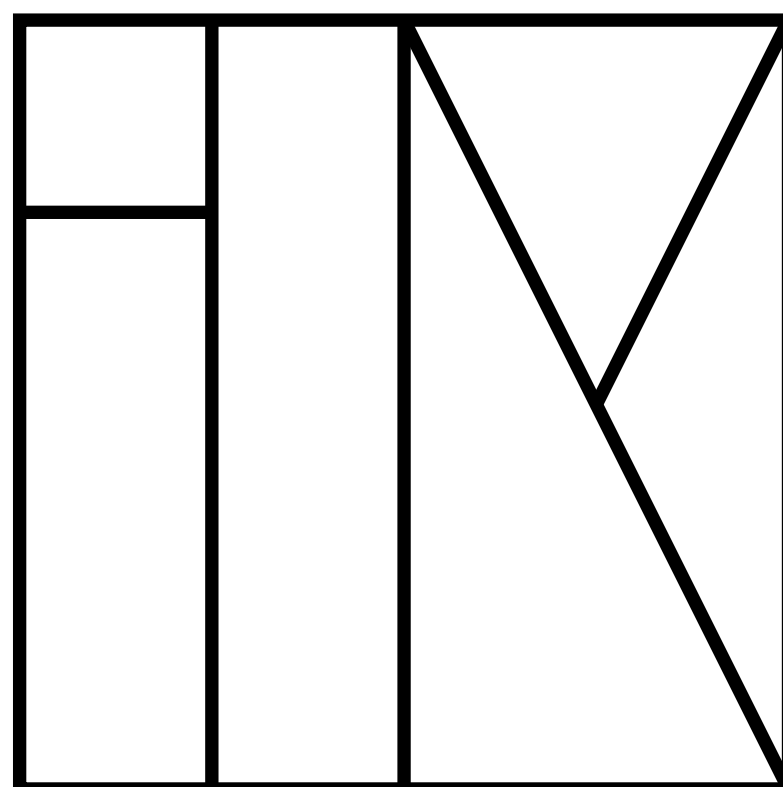
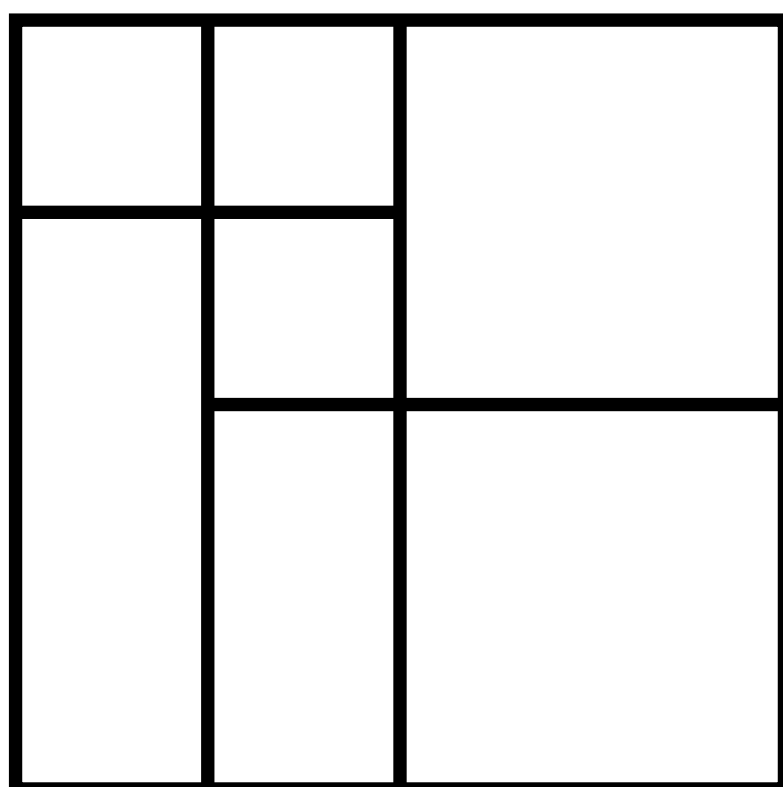
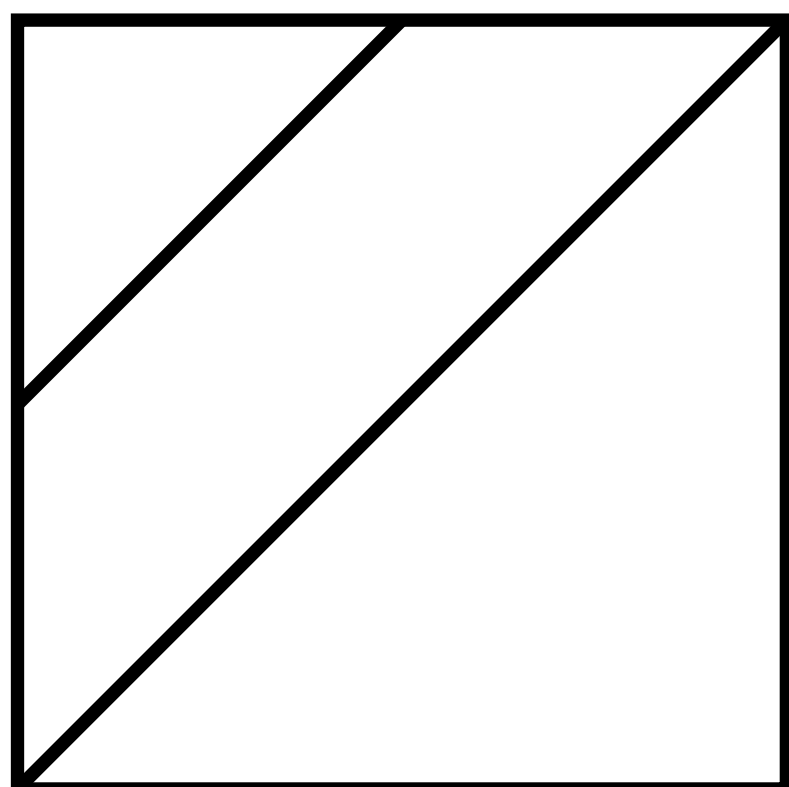
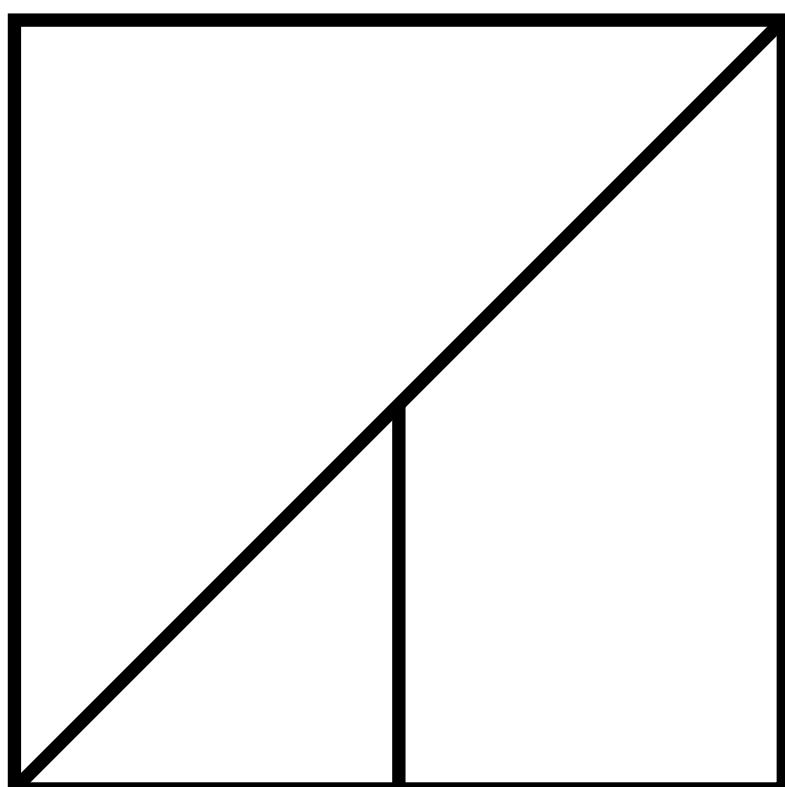
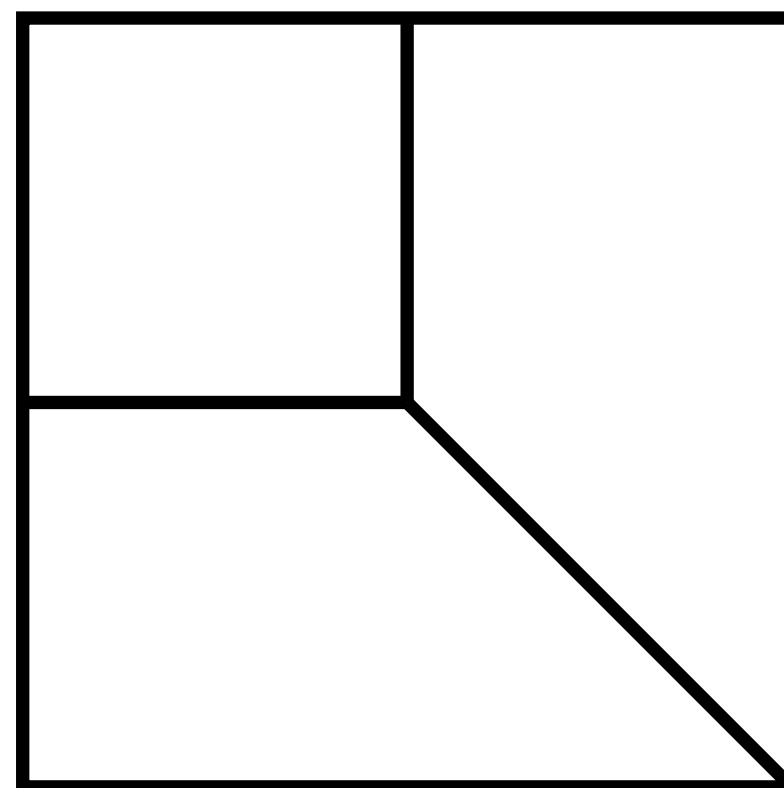
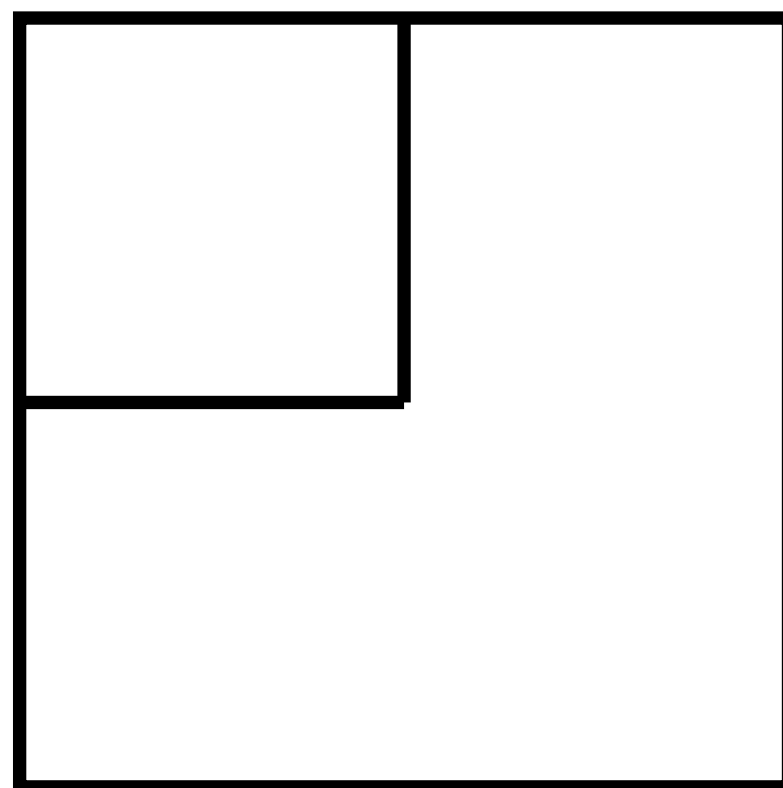
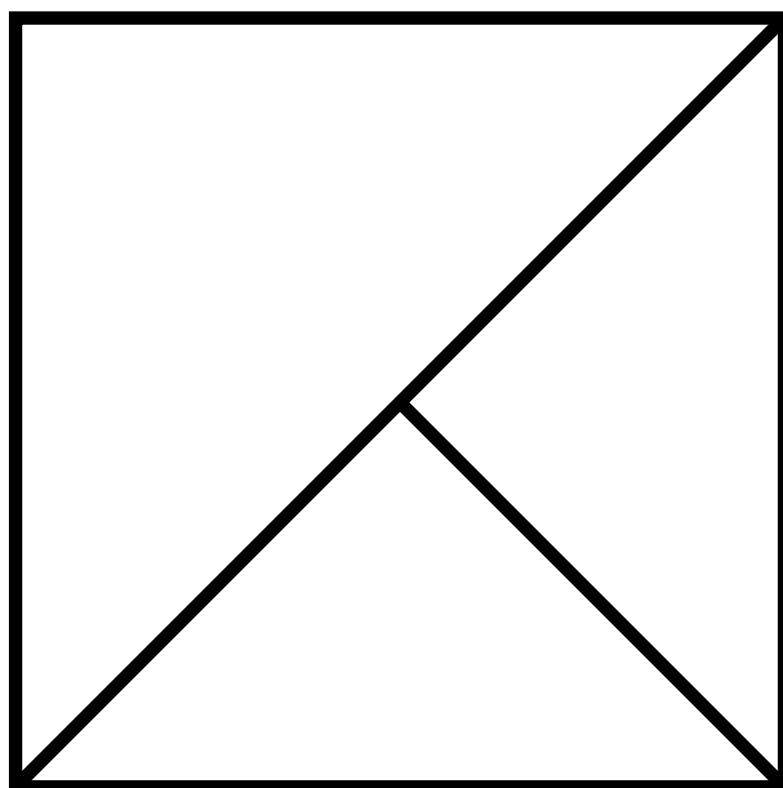
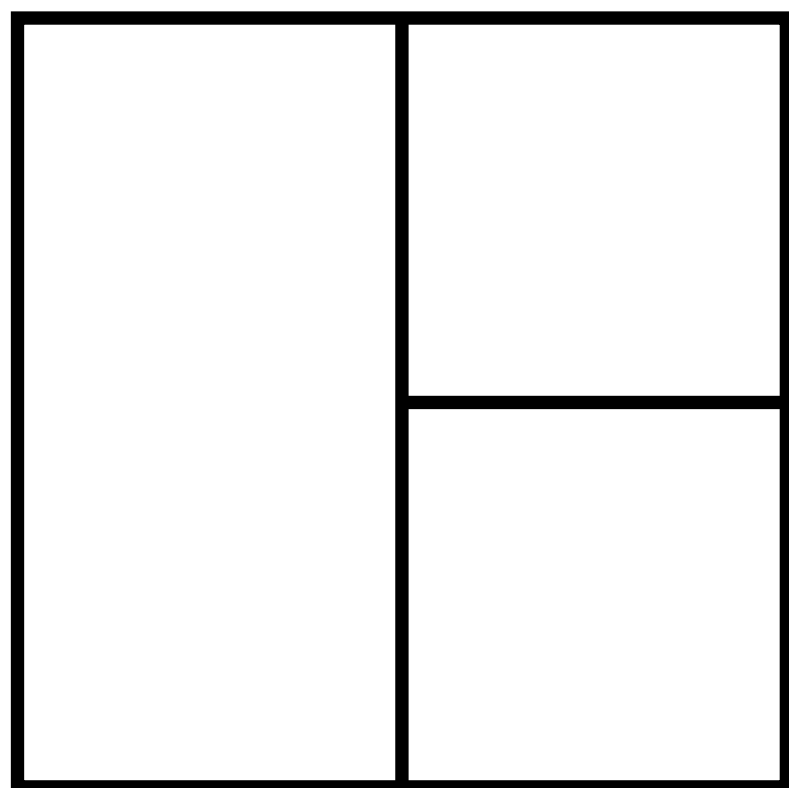
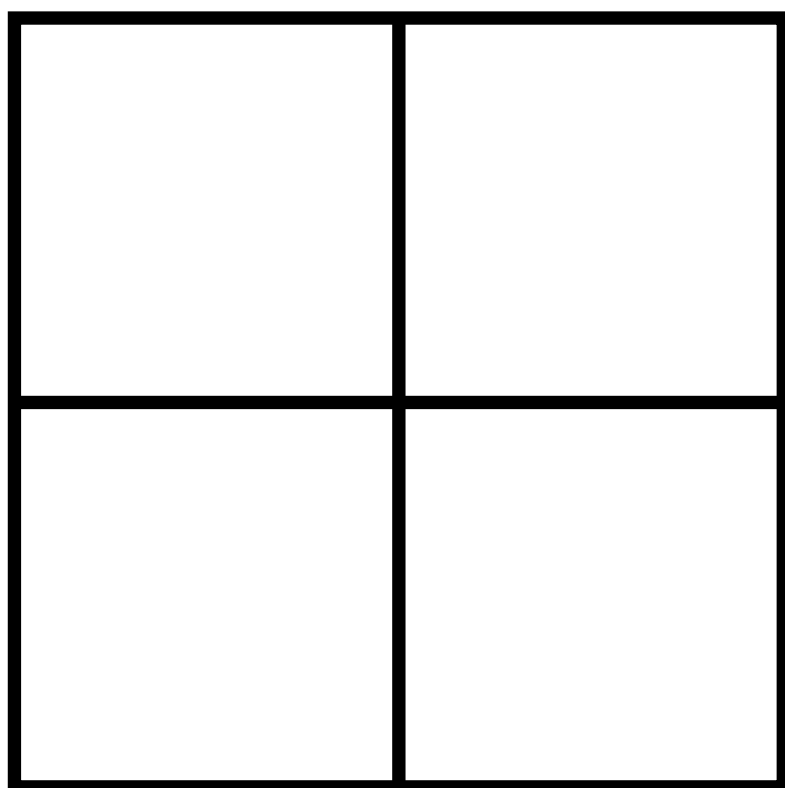
different representations

“Using [...] **different representations** is like examining the concept through a variety of lenses, with each lens providing a **different perspective** that makes the picture (concept) richer and deeper.”

Tripathi, P.N. (2008). Developing mathematical understanding through multiple representations. *Mathematics Teaching in the Middle School*, 13(8). 438-445. <https://doi.org/10.5951/MTMS.13.8.0438>

The Unusual Baker

The unusual baker. (2012). *Teaching Children Mathematics*, 19(5), 286–289. <https://doi.org/10.5951/teacchilmath.19.5.0286>



- accessible
- extendable
- invites collaboration
- different strategies
- explain ideas & justify decisions
- essential understandings

- accessible
- extendable
- invites collaboration
- different strategies
- explain ideas & justify decisions
- essential understandings
- pattern-seeking & generalizing
- different representations

2

Kaktovik Numerals

Burdess, A. (2024, November 16). The most beautiful experience. <https://www.aliciaburdess.com/post/the-most-beautiful-experience>



Kaktovik Iñupiaq Numerals

Using the clues, determine as many of the Kaktovik numerals from 0 to 19 as you can.

$$\backslash + \backslash = \vee$$

$$\backslash \times \backslash = \backslash$$

$$\vee + \backslash = \vee$$

$$\vee + \vee = \neg$$

$$W + W = \neg$$

$$\vee \times \nabla = \neg W$$

$$\neg \times \vee = \neg$$

$$\neg - \neg = \delta$$

$$\neg \times \vee = \backslash \delta$$

$$\neg \times \vee = \neg$$

$$\neg + \backslash = \neg$$

$$\vee \times \nabla = \backslash \backslash$$



0



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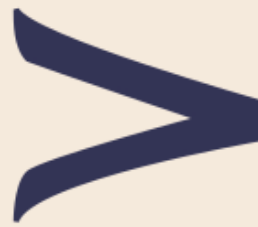
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18



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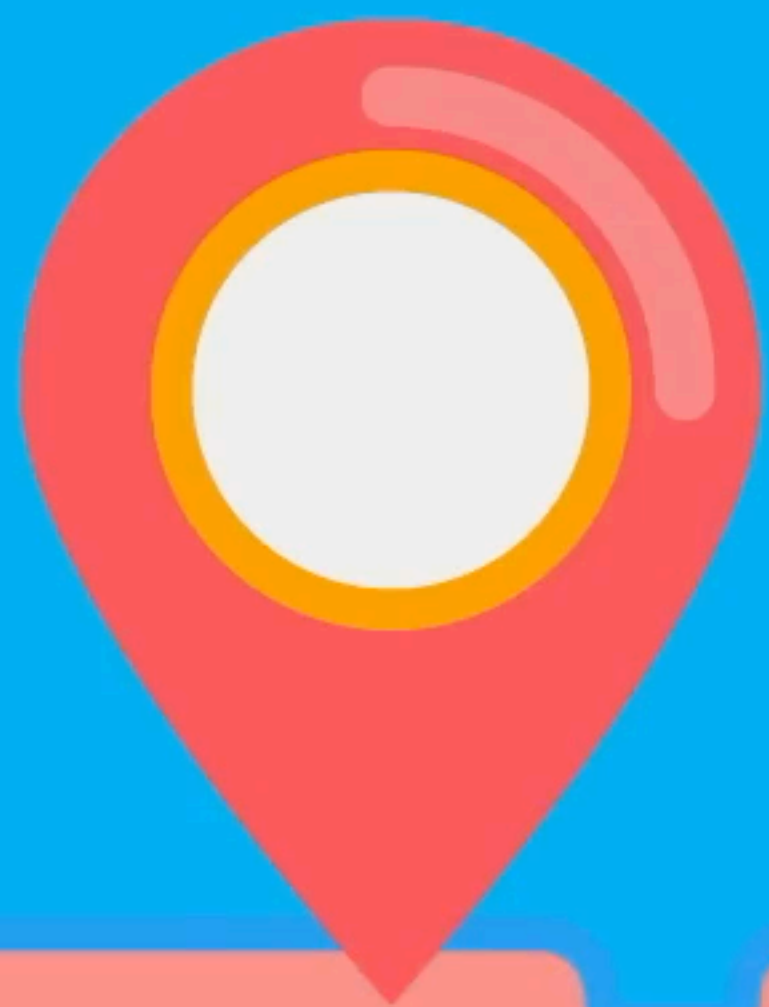
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Courtesy Patty Pollock



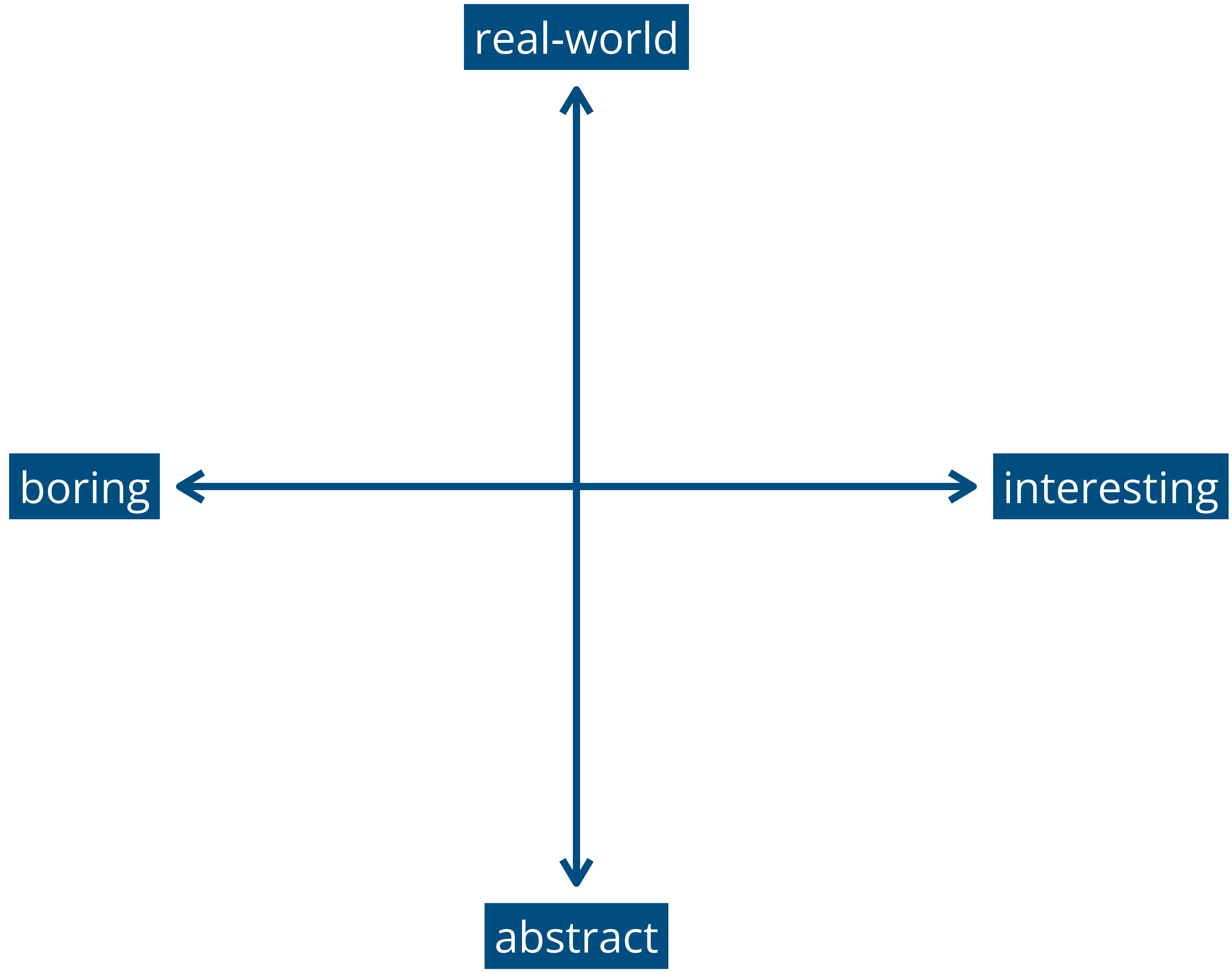
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intriguing









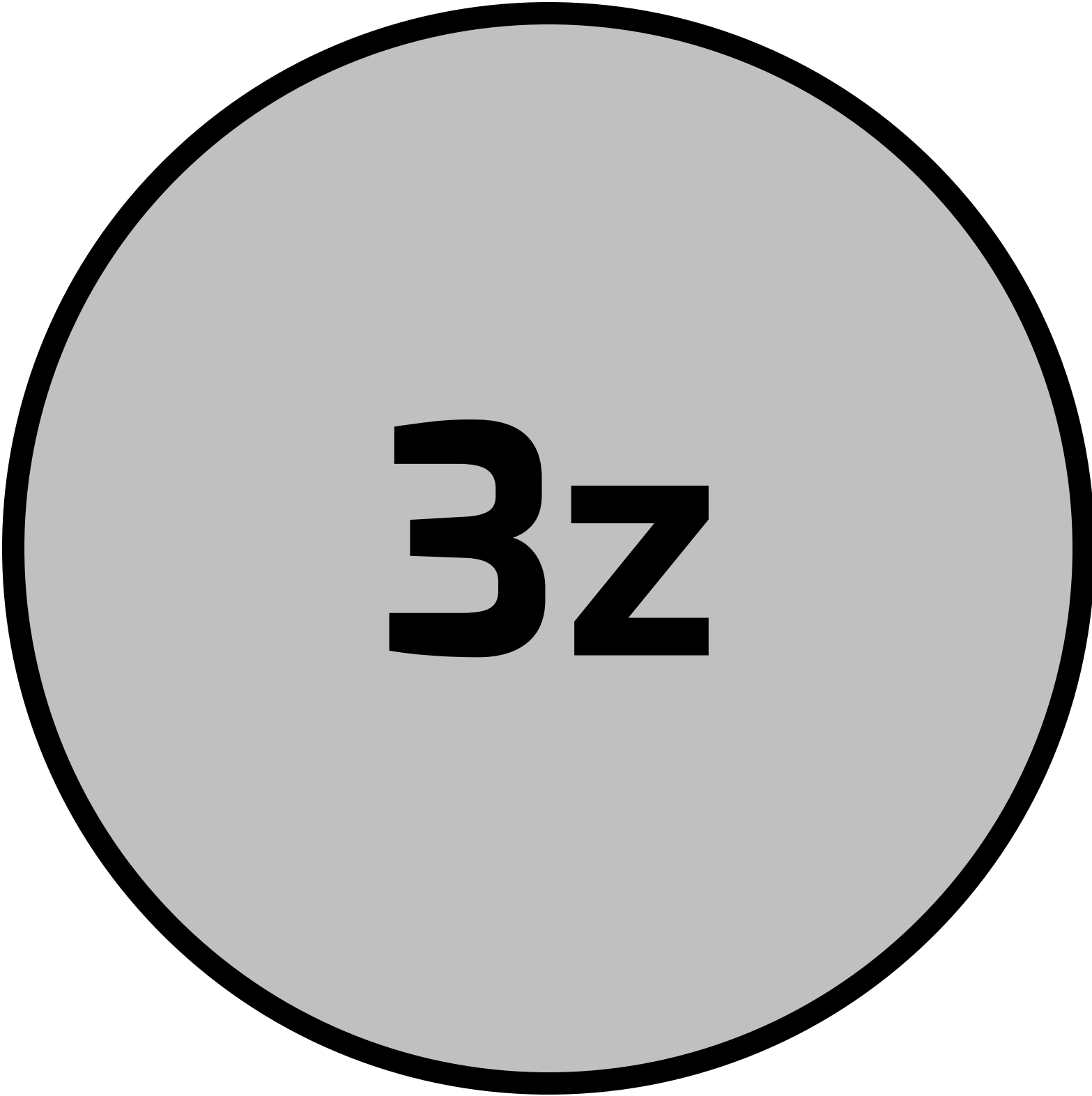
- accessible
- extendable
- invites collaboration
- different strategies
- explain ideas & justify decisions
- essential understandings
- pattern-seeking & generalizing

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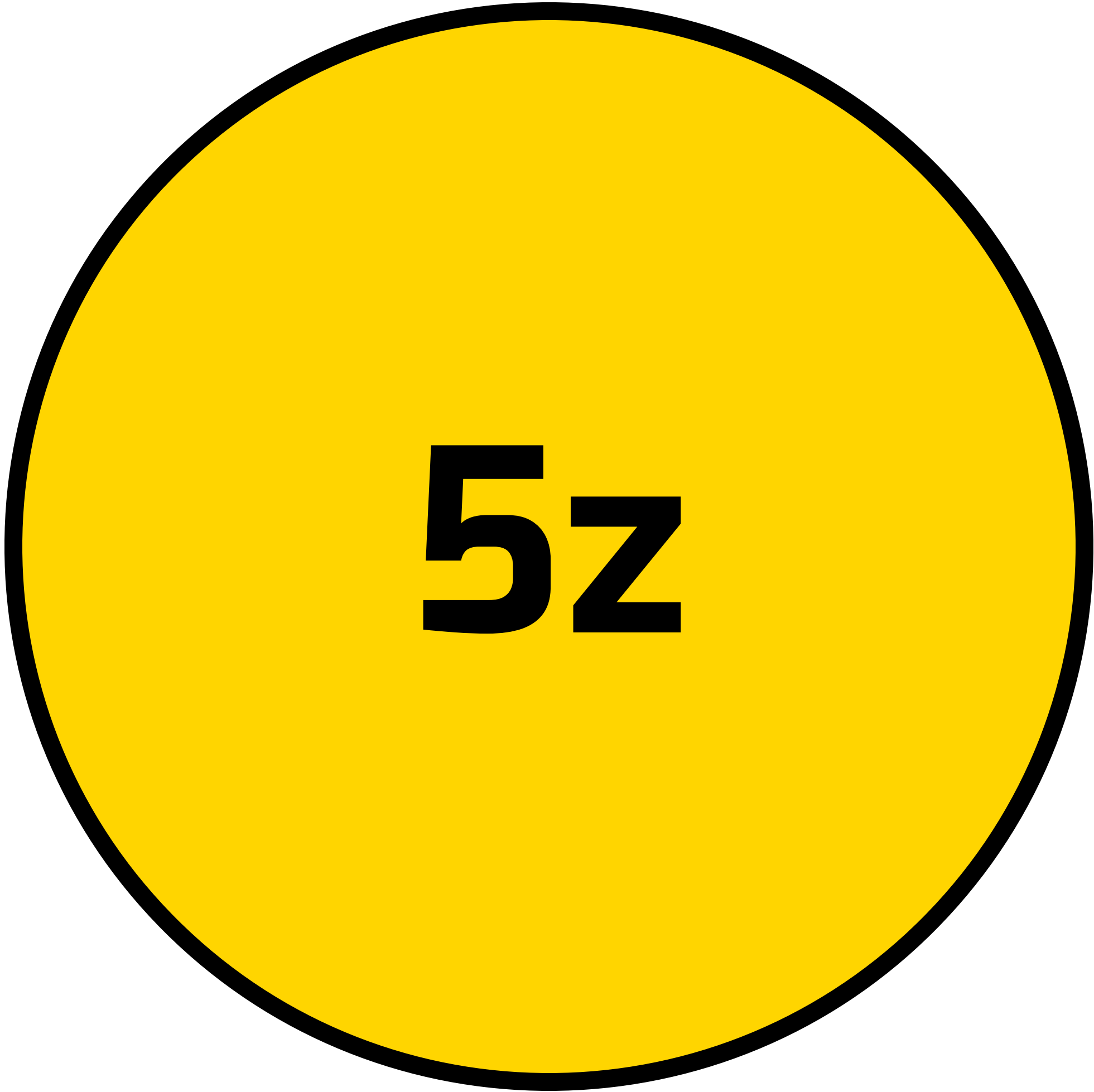
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How Much Can We Spend?

How much can we spend? NRICH. <https://nrich.maths.org/problems/how-much-can-we-spend>



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5z

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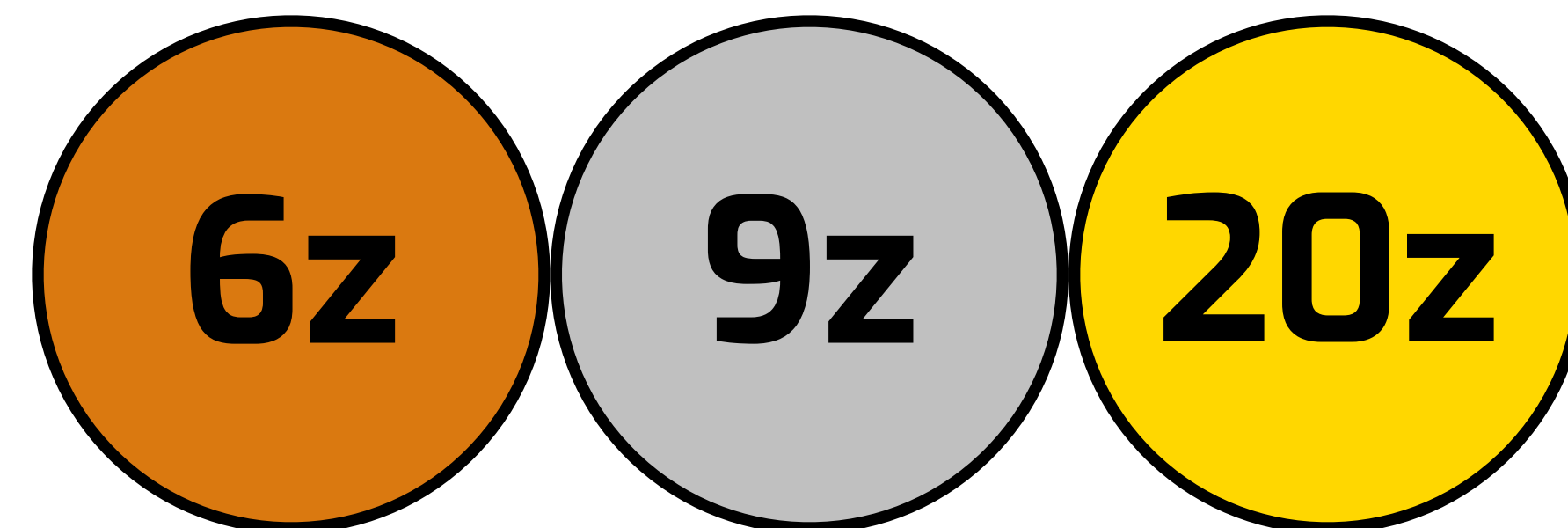
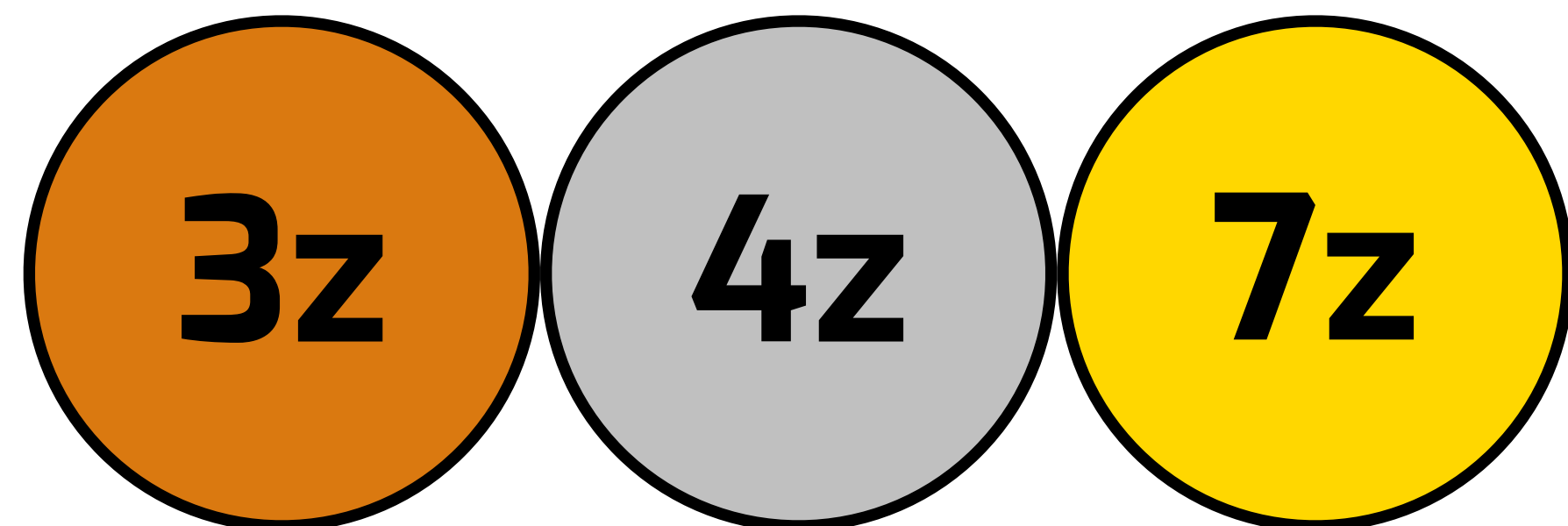
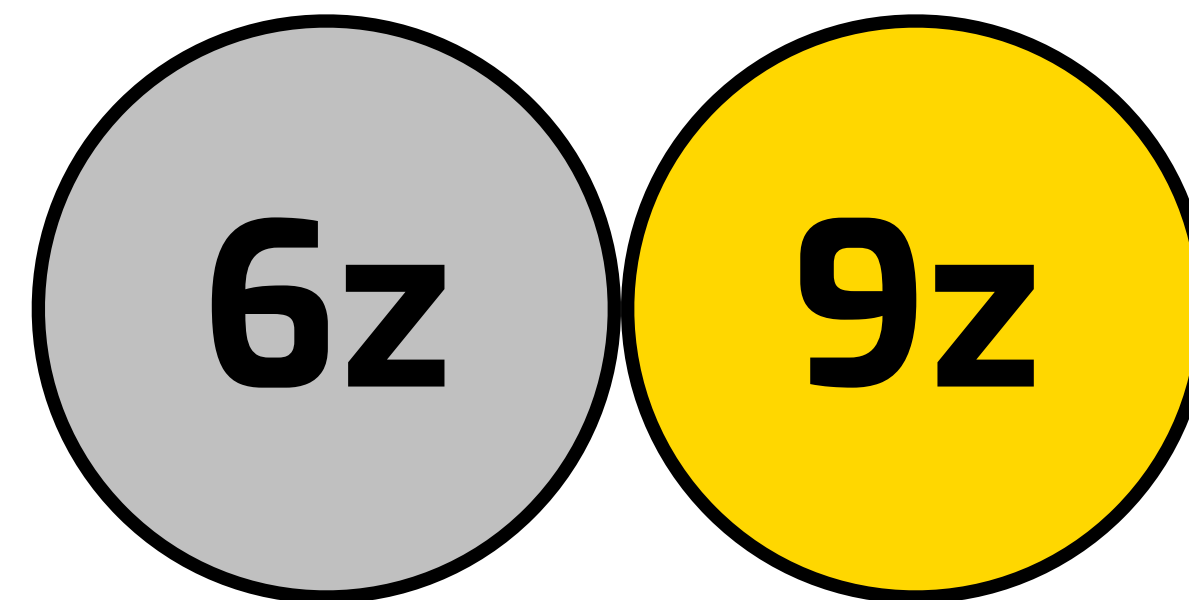
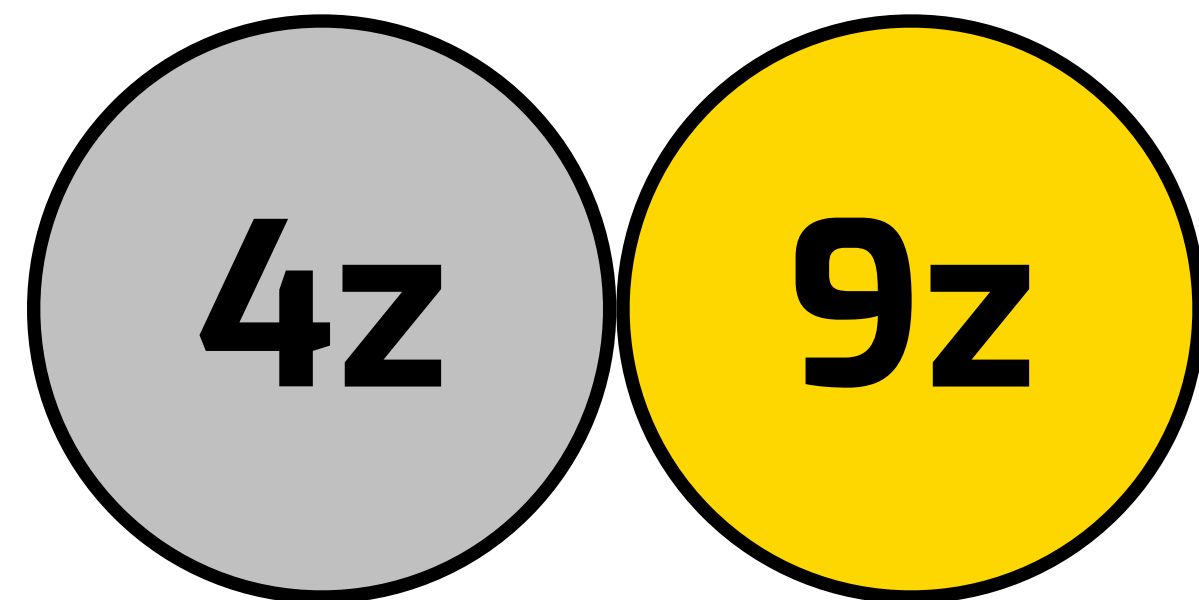
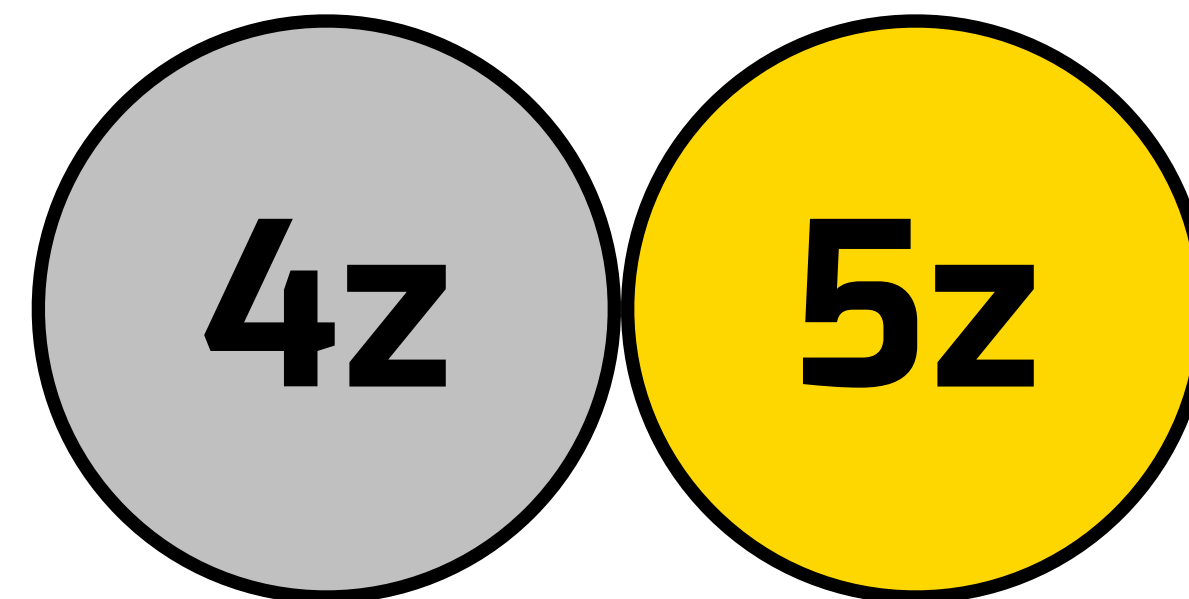
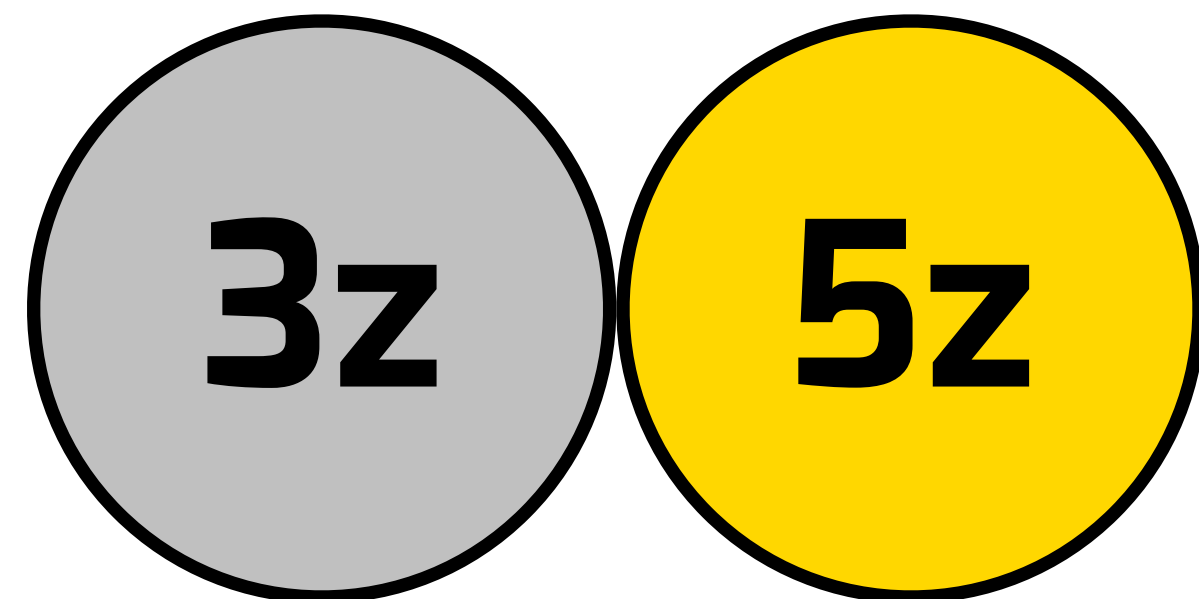
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McNugget Numbers





DIPPIN' CHICKEN TENDERS

Our 5-piece or 3-piece panko-breaded
Dippin' Chicken tenders are made from
100% BC chicken, served with your
choice of dip. Try them with our signature
honey mustard or Chipotle mayo.

DIPPIN' CHICKEN TENDERS

**What
do you
notice?**

**What
do you
wonder?**

**problem-posing & “what if...?”
questions**

“In mathematics the art of proposing a question must be held of higher value than solving it.”

Georg Cantor

“The way of mathematics is to make stuff up and see what happens.”

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Chris Hunter

K-12 Numeracy Helping Teacher

Surrey Schools

email: hunter_c@surreyschools.ca

Bluesky: [@chrishunter.bsky.social](https://bsky.social/@chrishunter)

blog: chrishunter.ca

