Dots and Boxes XYZ

Photo by Kamyar Adl

Contents

Standard rules for Dots & Boxes ..... http://en.wikipedia.org/wiki/Dots_and_Boxes
(only for those unfamiliar)

Rules for Dots and Boxes xyz 3

Common Core Standards 4

$500 classroom challenge 5

Most of the first class will be spent here.

Projectable game for the whole class 6

Printable game-sheets 8

Projectable game with exponents for whole class 15

Printable game-sheets with exponents 16

Some students benefit from being creative and designing their own game boards.

Make your own game board 22

Sample Game of standard Dots and Boxes 24
(not for the class!)

About MathPickle 27

The original idea for using algebra with Dots and Boxes game came from "Algebra 4 All." You can buy their original product here: http://www.teacherspayteachers.com/Store/Algebra4all

Dots and Boxes xyz

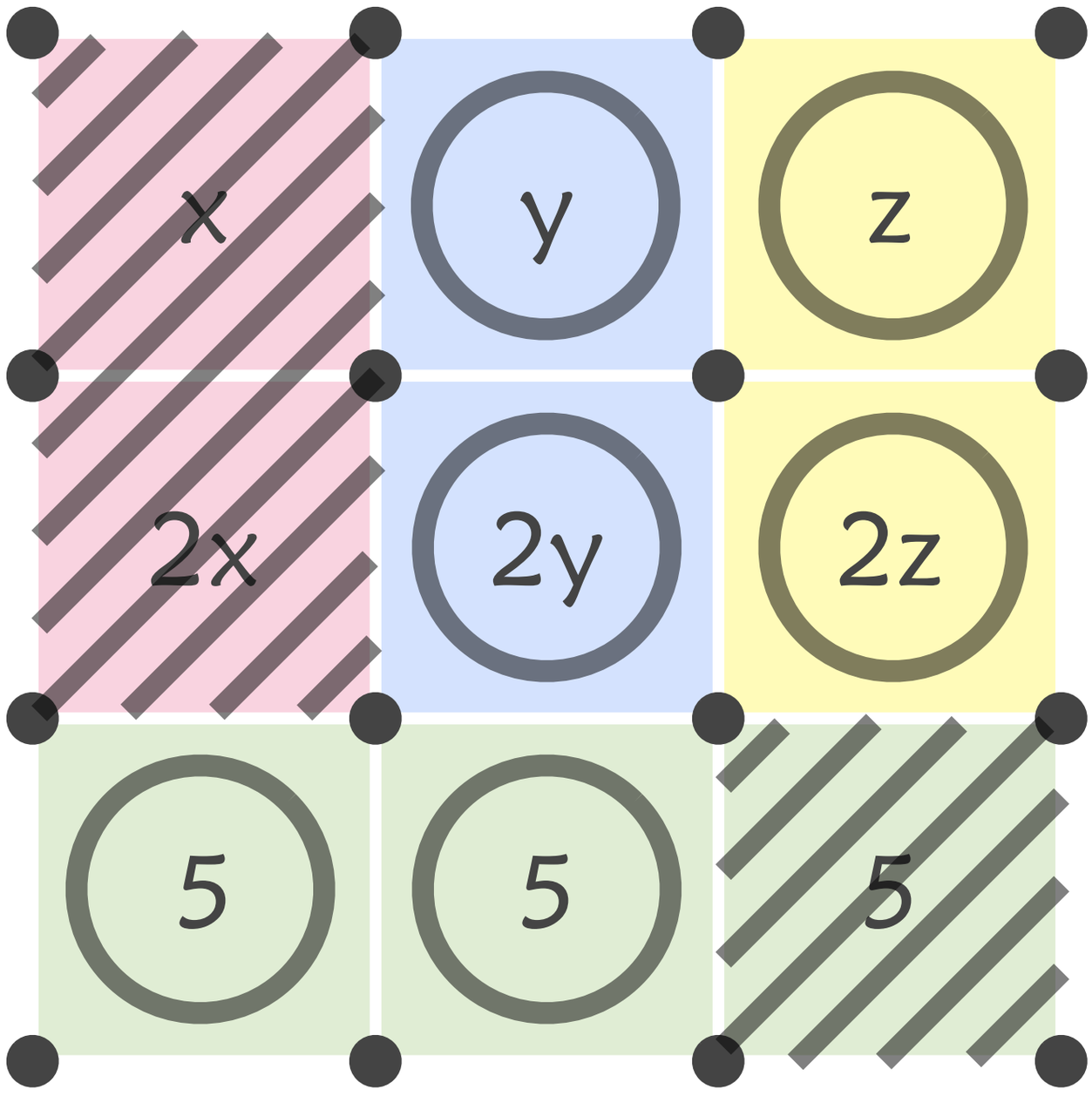
This is ordinary dots and boxes except:

1) When you win a box, its value is often determined by a variable x, y or z. Example: a box labelled 2z is worth 22 if z = 11.

2) Once during the game you may skip adding a line and change the value of a variable by ±10. A variable that has been changed cannot be changed again.

3) The game is immediately over once all the boxes are filled. Variables cannot be changed after the boxes are all filled.

4) The winner is the person with the highest score (or the least negative score.)



$x = 3$

$y = 2 \text{-10} = \text{-8}$

$z = 1 \text{+10} = 11$

Score:

$y+2y+z+2z+5+5=19$

Score:

$x+2x+5=14$

Standards for Mathematical Practice

All MathPickle puzzle designs, including **Dots and Boxes xyz**, 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.

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

Common Core State Standards

Dots and Boxes xyz targets the following Common Core State Standards from grades 6-10:

CCSS.MATH.CONTENT.6.EE.A.2
Write, read, and evaluate expressions in which letters stand for numbers.

CCSS.MATH.CONTENT.6.EE.A.2.A
Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation "Subtract y from 5" as 5 - y.

CCSS.MATH.CONTENT.6.EE.A.4
Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.

CCSS.MATH.CONTENT.7.EE.B.4
Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

CCSS.MATH.CONTENT.HSA.CED.A.2
Create equations in two or more variables to represent relationships between quantities.

CCSS.MATH.CONTENT.HSF.BF.A.1
Write a function that describes a relationship between two quantities.

$500 classroom challenge

Perhaps your students have created a beautiful Dots and Boxes xyz game board or a student who is not usually excited about math has become engaged. Perhaps a pair of students discovered that they can guarantee a win for the first or second player on one of the very small boards. Whatever your inspirational experience with this gem of a game, I'd like to know.

I'll offer $500 for a photograph and/or story highlighting Dots and Boxes xyz in the classroom.

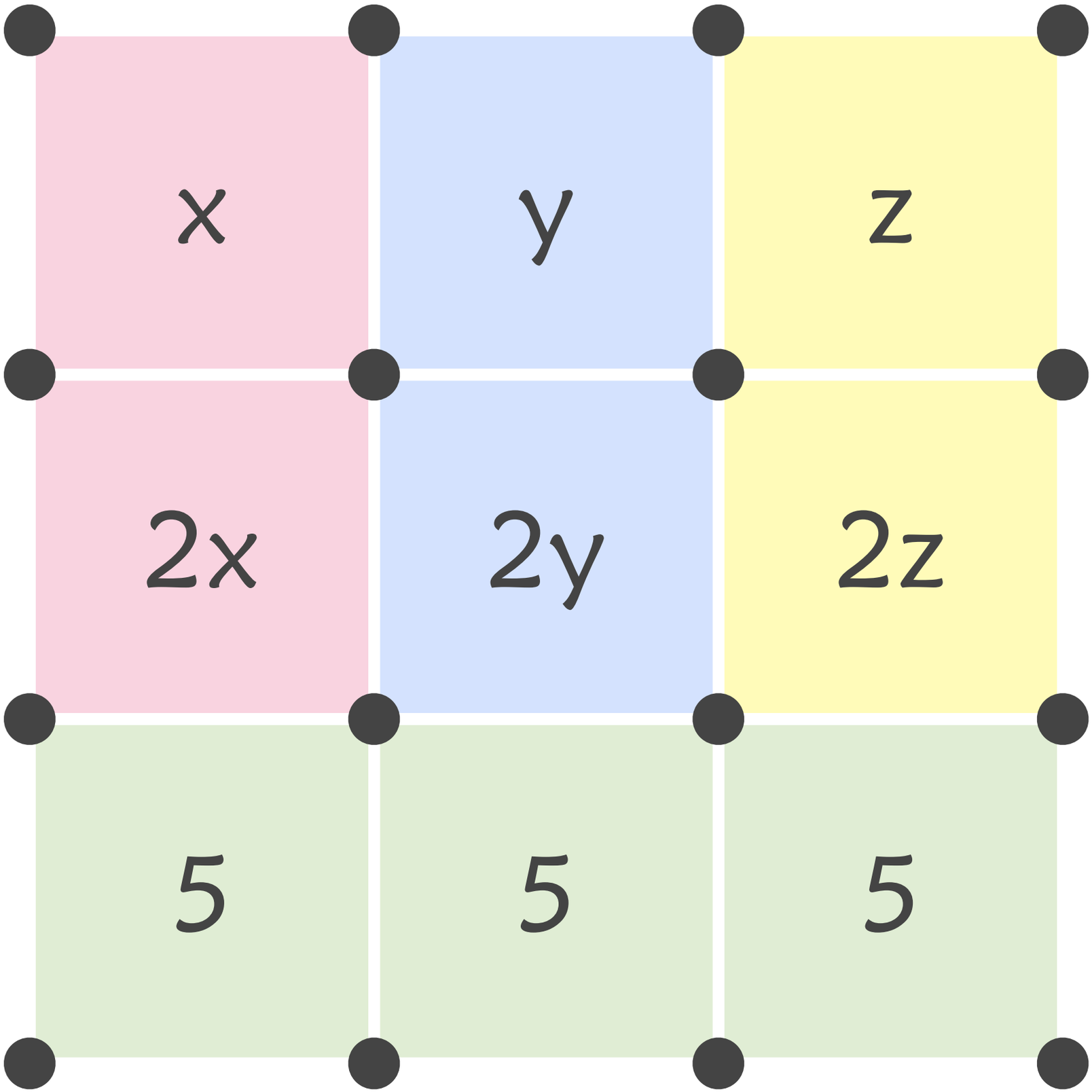
All students featured must have appropriate consent. All photographs and stories submitted may be used in an updated version of this pdf file and to promote this game elsewhere.

Send submissions to gord@mathpickle.com. Use "$500 Dots and Boxes xyz 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.

Dots and Boxes

XYZ

Photo by darkday



$x = 3$

$y = 2$

$z = 1$

Score:

Score:

Dots and Boxes xyz

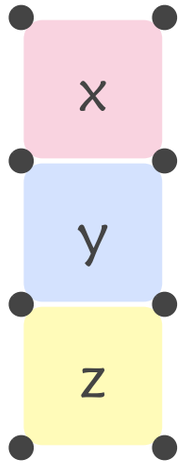
This is ordinary dots and boxes except:

1) When you win a box, its value is often determined by a variable x, y or z. Example: a box labelled 2z is worth 24 if z = 12.

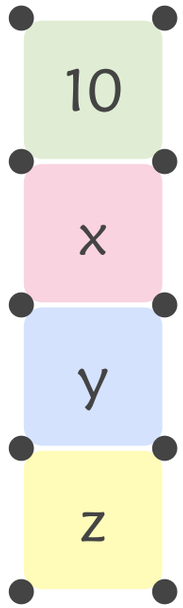
2) Once during the game you may skip adding a line and change the value of a variable by ±10. A variable that has been changed cannot be changed again.

3) The game is immediately over once all the boxes are filled. Variables cannot be changed after the boxes are all filled.

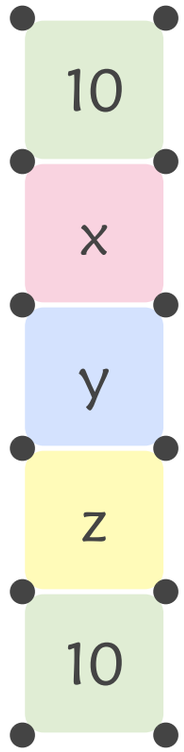
4) The winner is the person with the highest score (or the least negative score.)



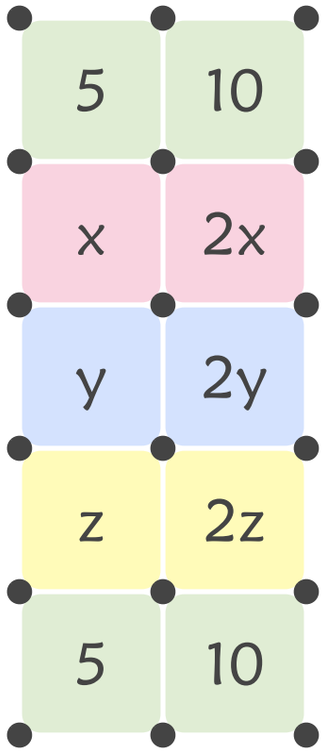
x = 4
y = 3
z = 2



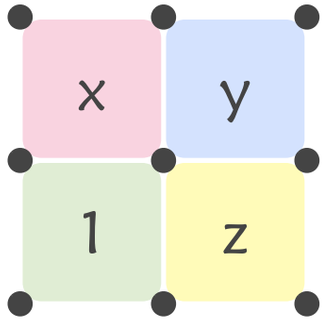
x = 4
y = 3
z = 2



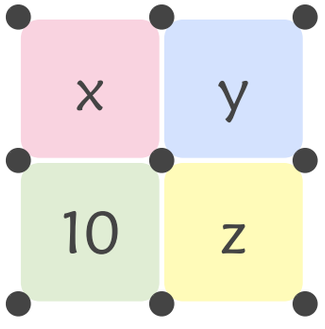
x = 4
y = 3
z = 2



x = 4
y = 3
z = 2



x = 4
y = 3
z = 2



x = 4
y = 3
z = 2

Dots and Boxes xyz

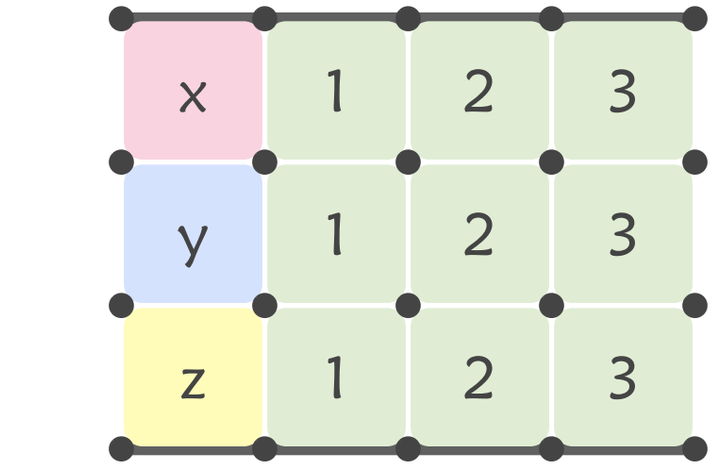
This is ordinary dots and boxes except:

1) When you win a box, its value is often determined by a variable x, y or z. Example: a box labelled 4z is worth 60 if z = 15.

2) Once during the game you may skip adding a line and change the value of a variable by ±10. A variable that has been changed cannot be changed again.

3) The game is immediately over once all the boxes are filled. Variables cannot be changed after the boxes are all filled.

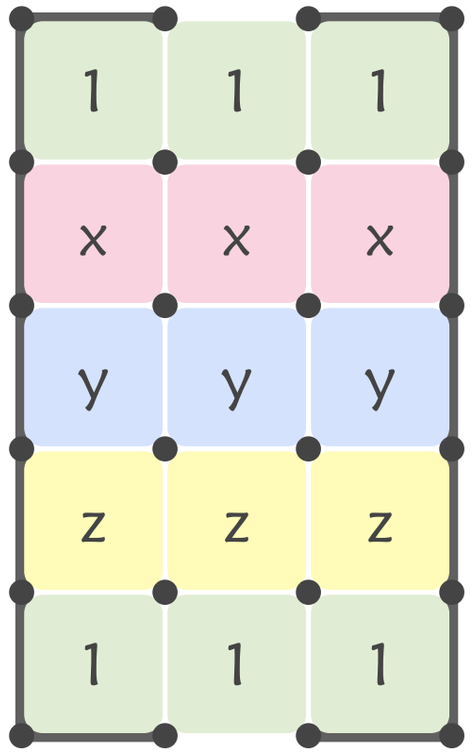
4) The winner is the person with the highest score (or the least negative score.)



x = 7

y = 6

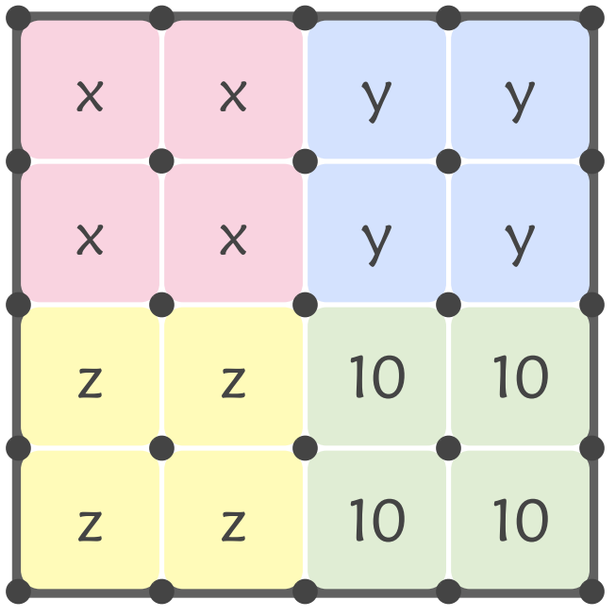
z = 5



x = 7

y = 6

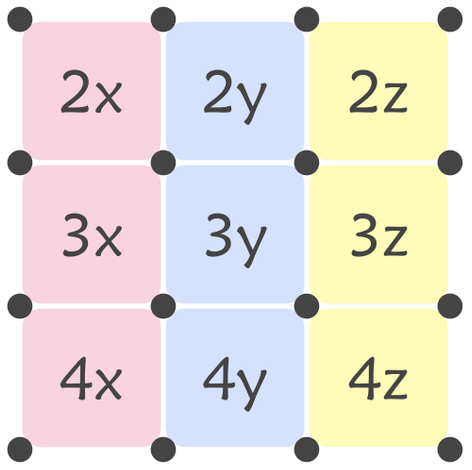
z = 5

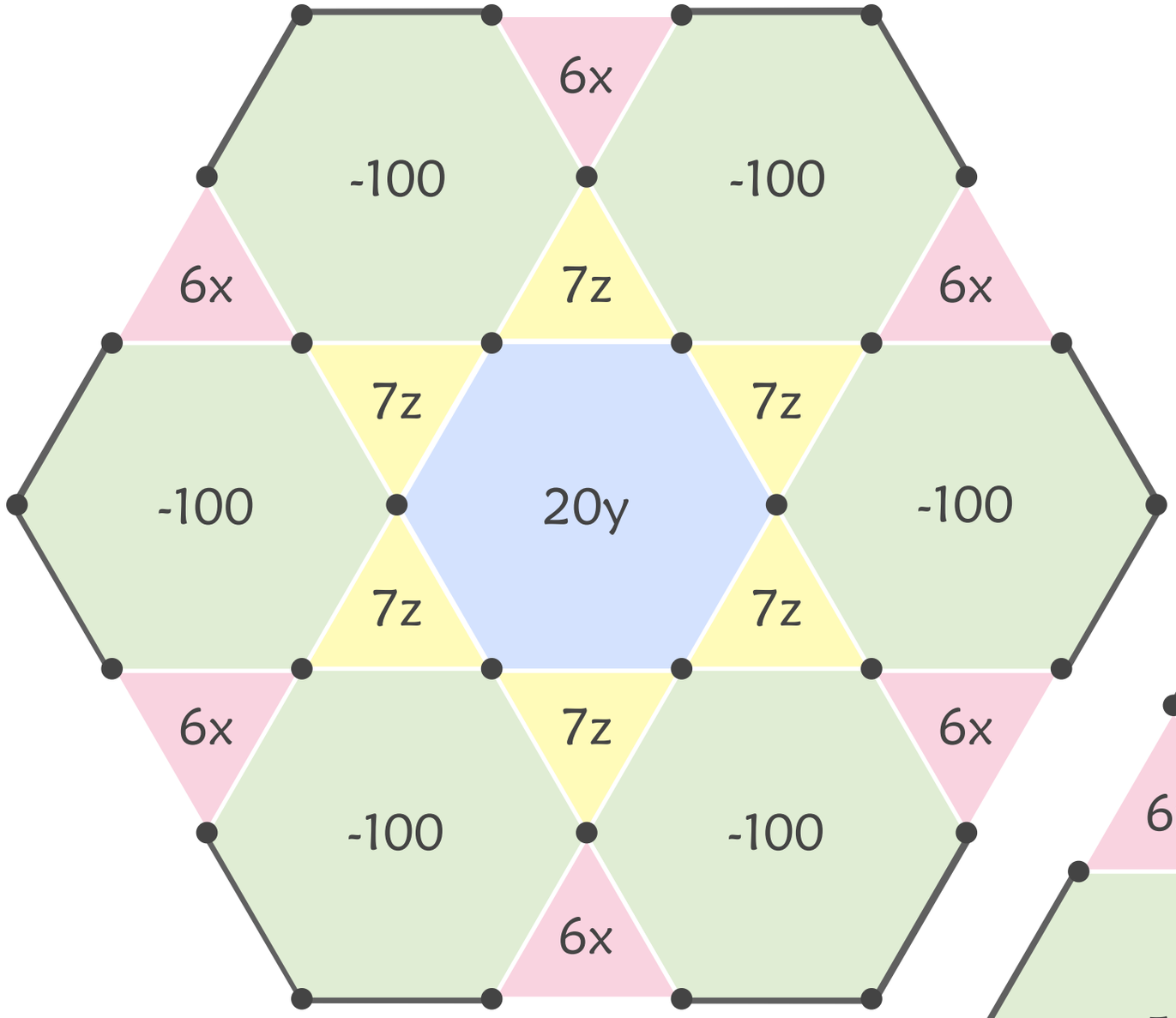


x = 7

y = 6

z = 5

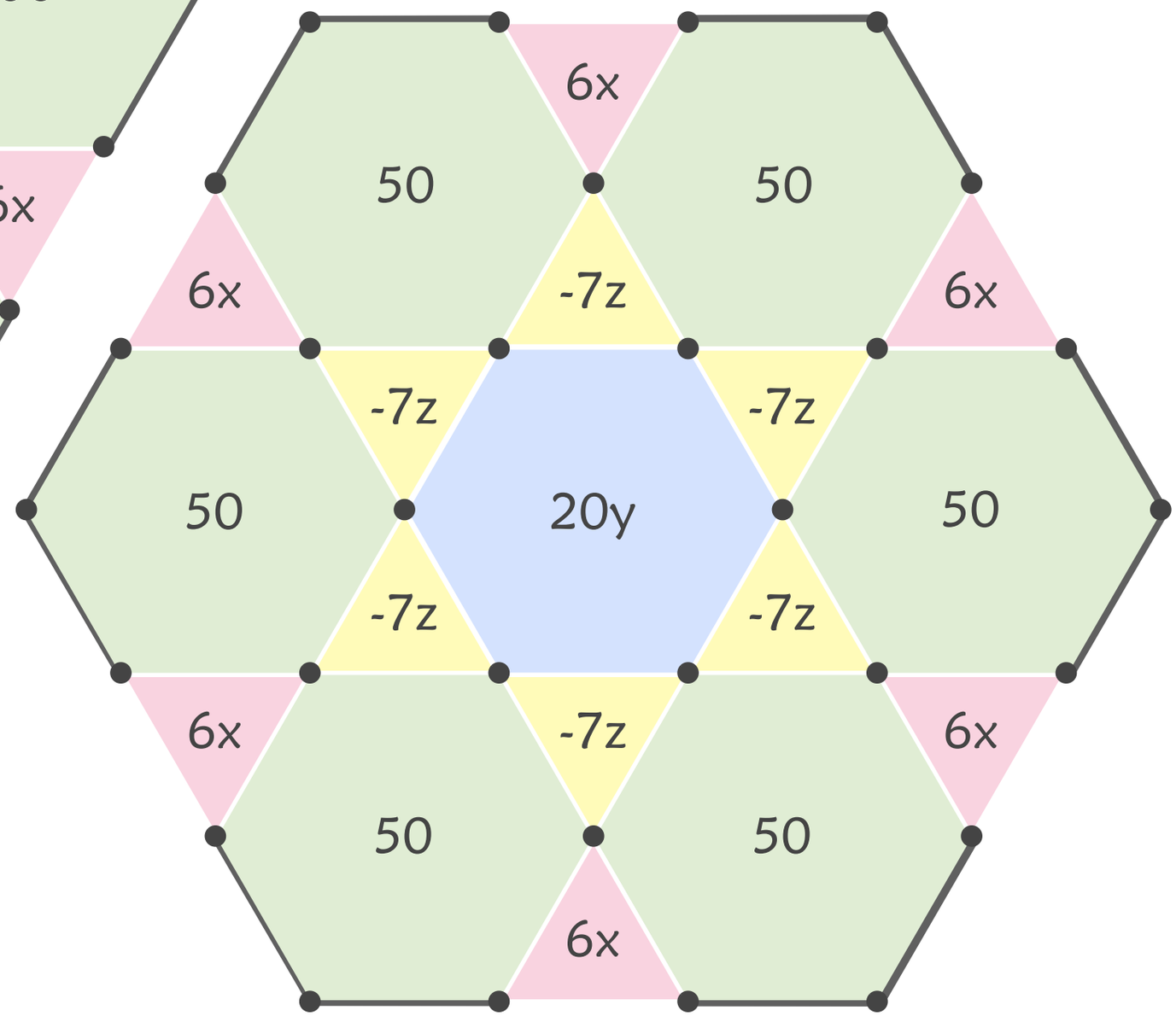




x = 10

y = 9

z = 8



x = 10

y = 9

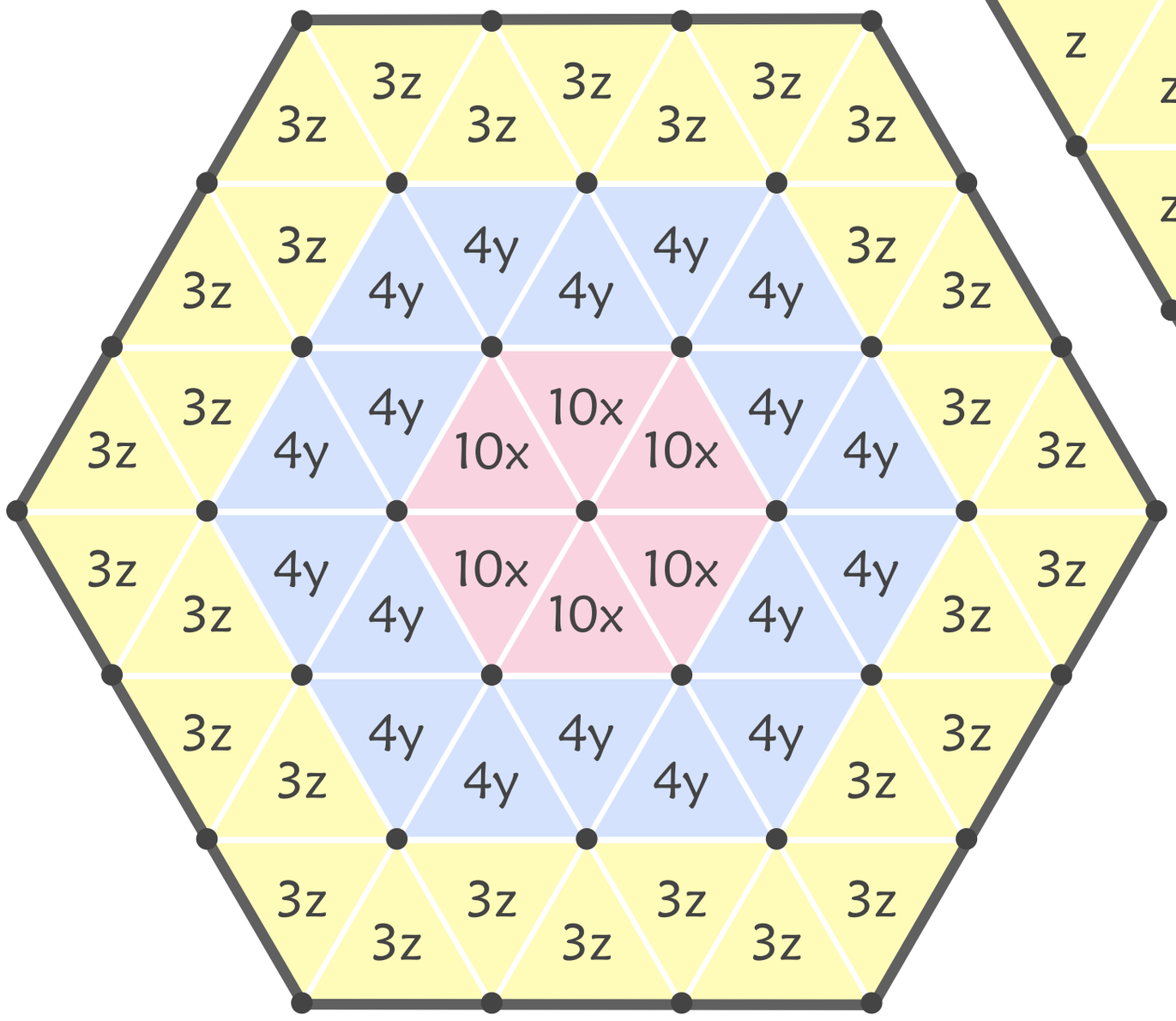
z = 8

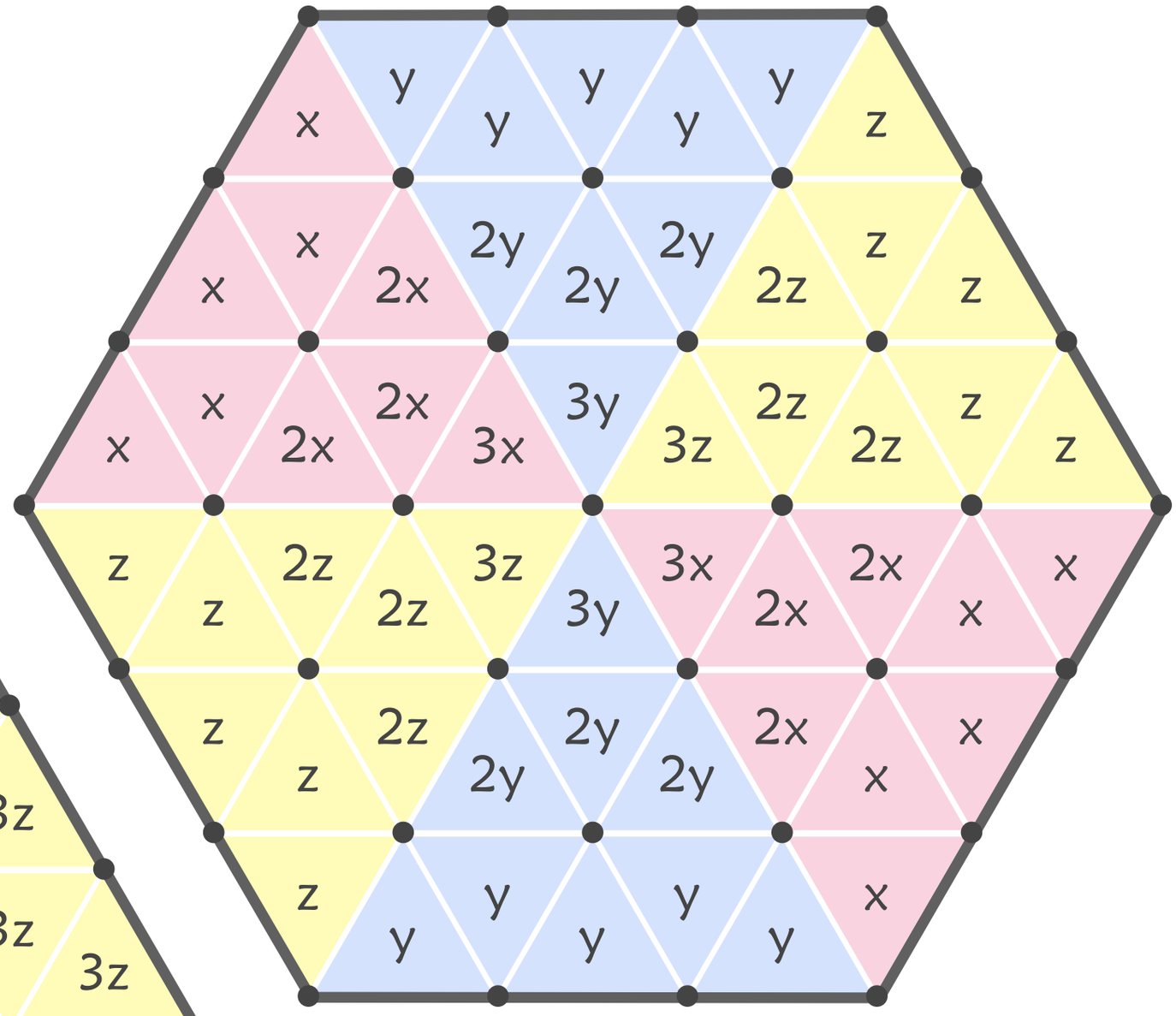
Here the “boxes” are triangular or hexagonal, but the same rules apply. Whoever adds the last edge of a shape gets that shape and an extra turn.

x = 1

y = 0

z = -1





x = 1

y = 0

z = -1

Dots and Boxes xyz

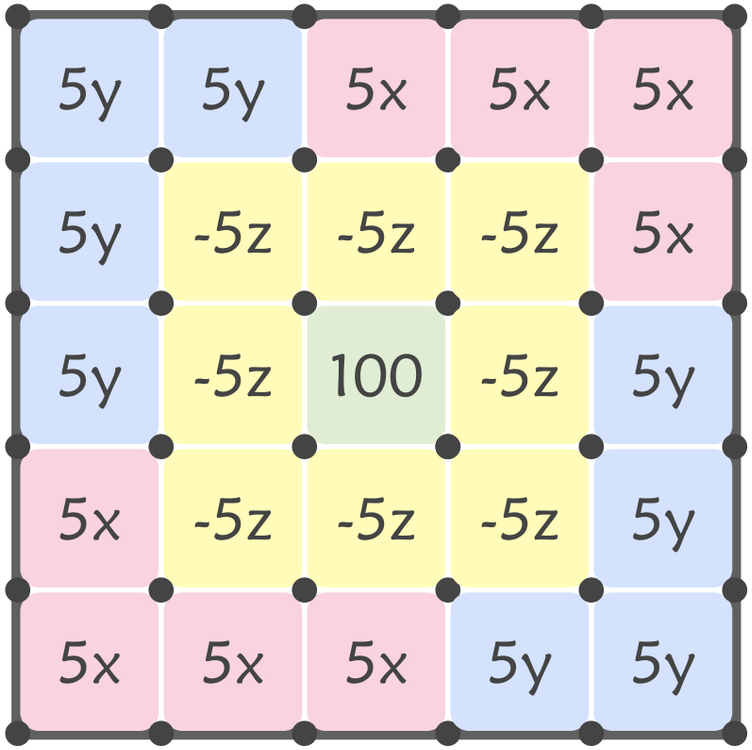
This is ordinary dots and boxes except:

1) When you win a box, its value is often determined by a variable x, y or z. Example: a box labelled 4z is worth 60 if z = 15.

2) Once during the game you may skip adding a line and change the value of a variable by ±10. A variable that has been changed cannot be changed again.

3) The game is immediately over once all the boxes are filled. Variables cannot be changed after the boxes are all filled.

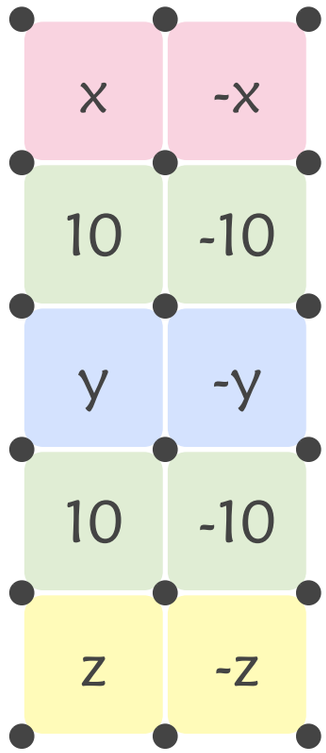
4) The winner is the person with the highest score (or the least negative score.)



x = 5

y = 5

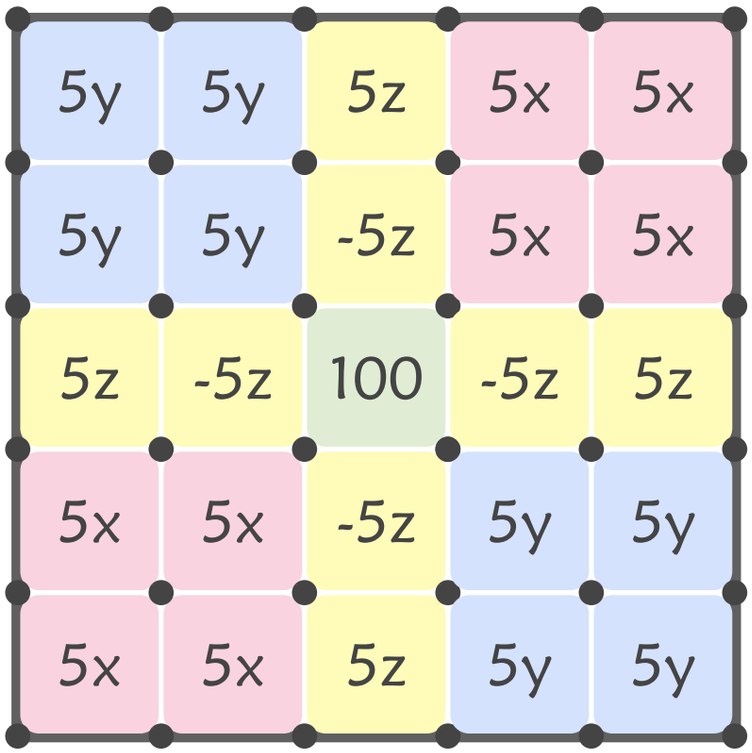
z = 5



x = 1

y = 1

z = 1



x = 5

y = 5

z = 5

Dots and Boxes xyz

This is ordinary dots and boxes except:

1) When you win a box, its value is often determined by a variable x, y or z. Example: a box labelled 4z is worth 12 if z = 3.

2) Once during the game you may skip adding a line and change the value of a variable by ±10. A variable that has been changed cannot be changed again.

3) The game is immediately over once all the boxes are filled. Variables cannot be changed after the boxes are all filled.

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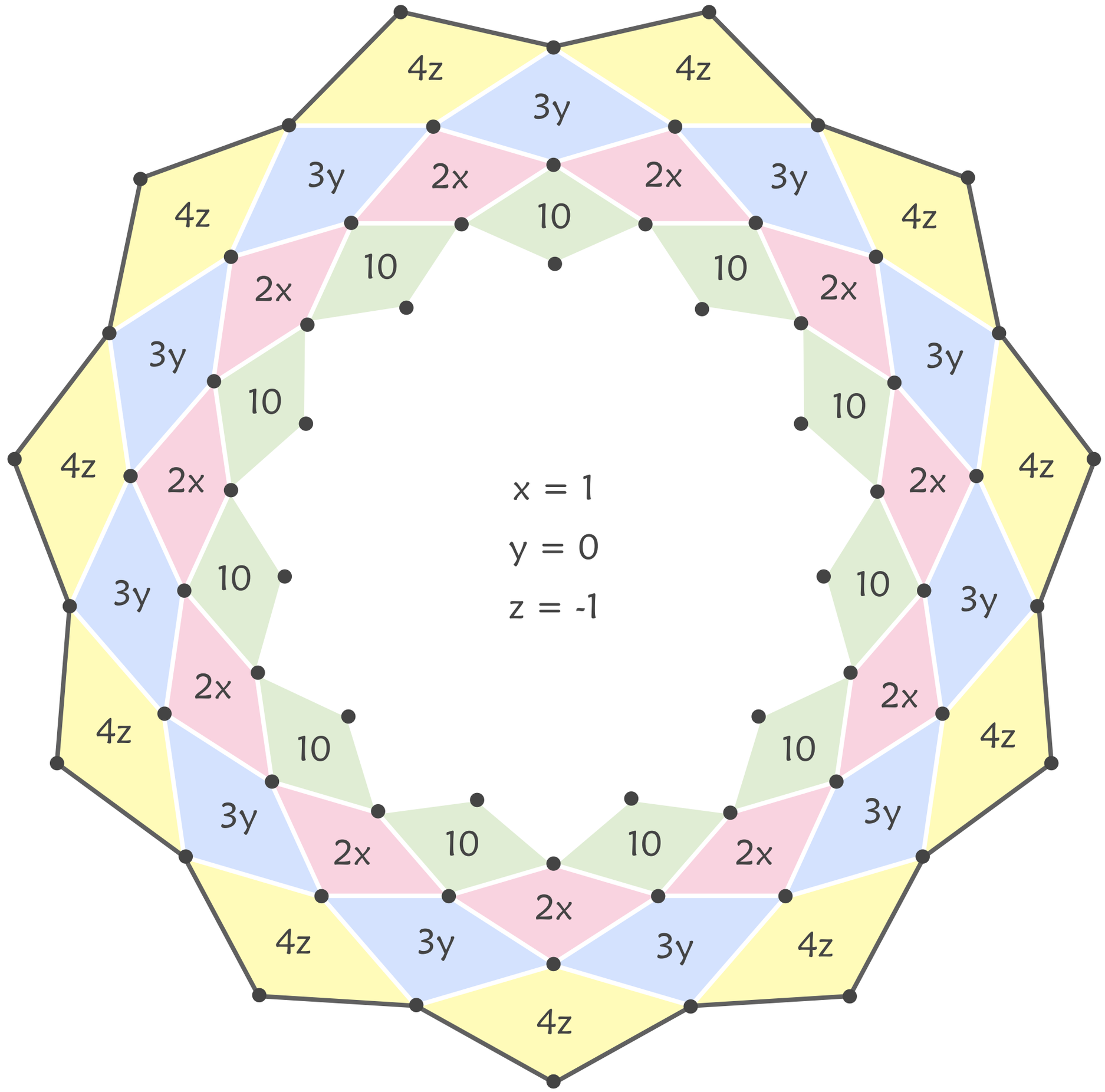
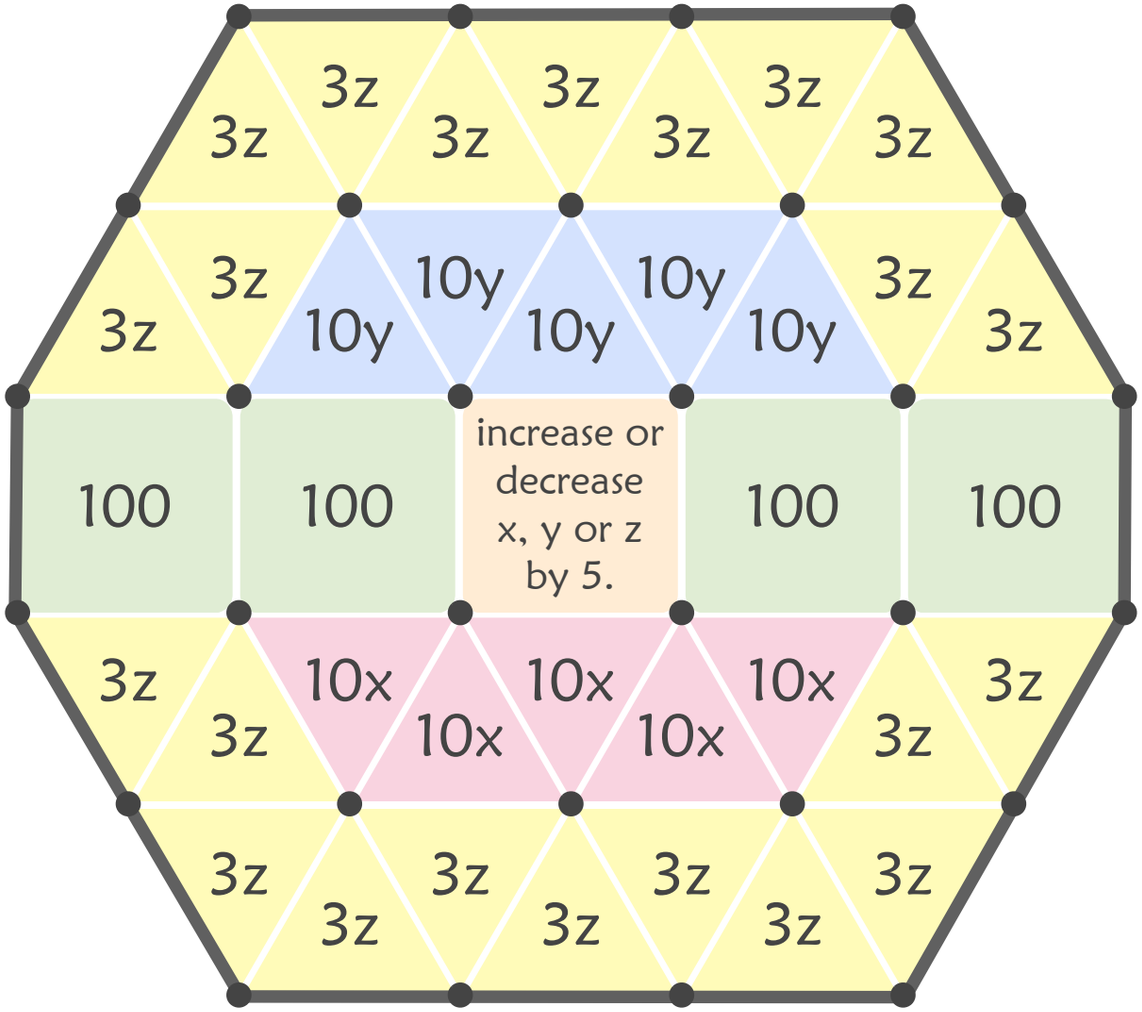


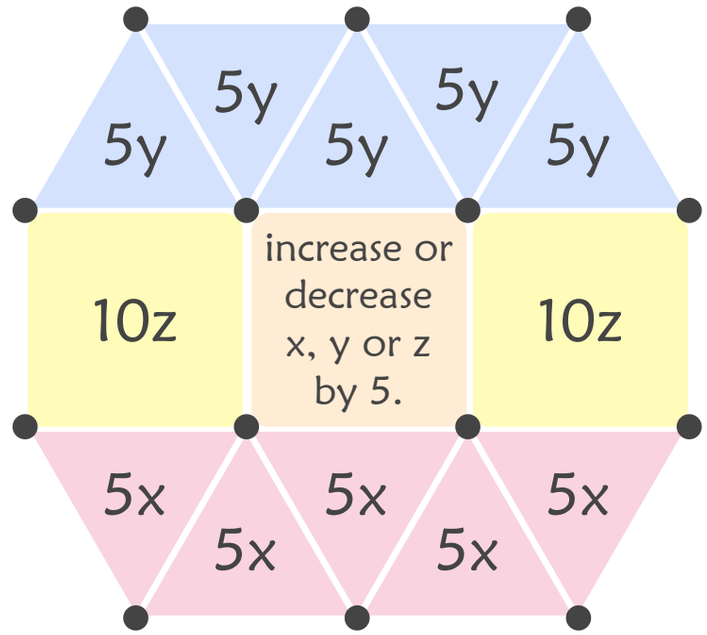
x = 2

y = 1

z = 0



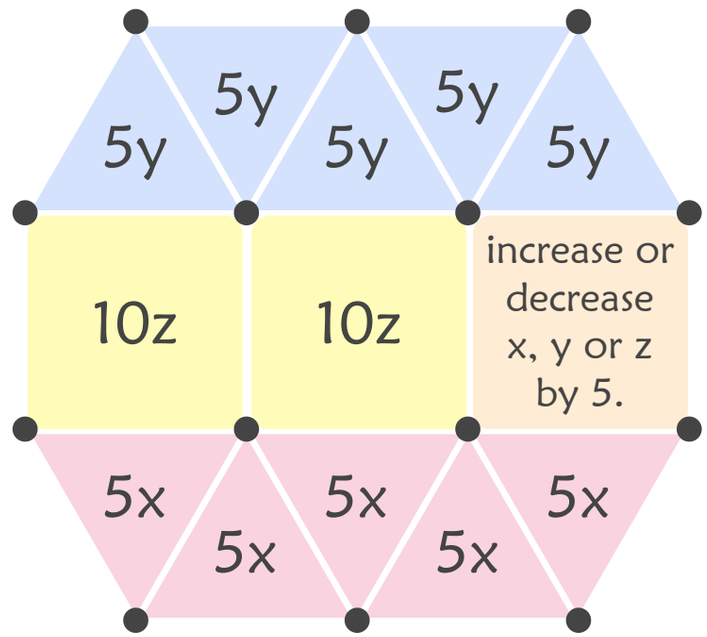
The central square allows the person who completes it to immediately increase or decrease x, y or z by 5. This cannot be done for a variable that has already been changed. It cannot be done if this is the last square to be filled. After filling in the square, the player still has another turn.



x = 2

y = 1

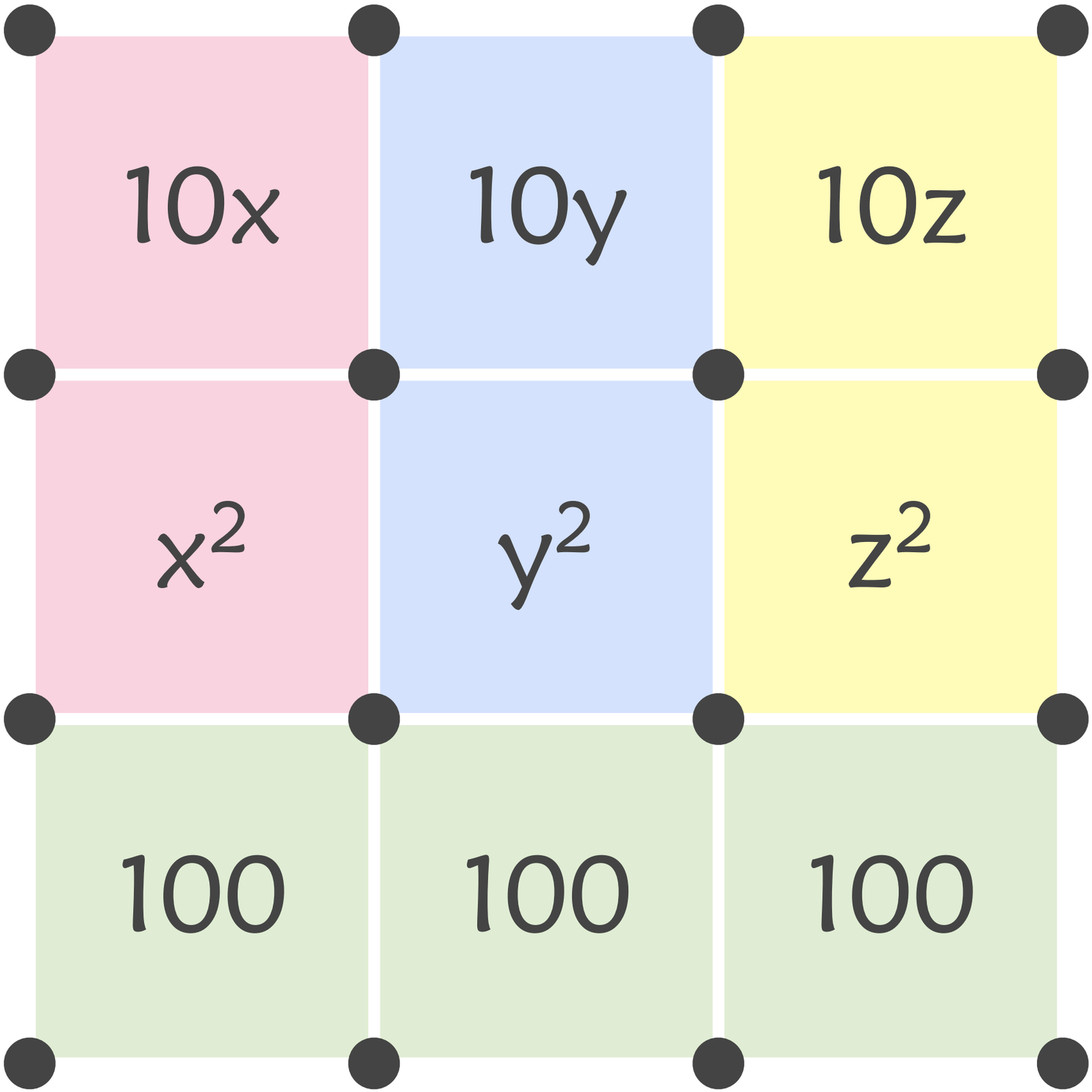
z = 0



x = 2

y = 1

z = 0



$x = 3$

$y = 2$

$z = 1$

Score:

Score:

Dots and Boxes xyz

This is ordinary dots and boxes except:

1) When you win a box, its value is often determined by a variable x, y or z. Example: a box labelled 4z is worth 60 if z = 15.

2) Once during the game you may skip adding a line and change the value of a variable by ±10. A variable that has been changed cannot be changed again.

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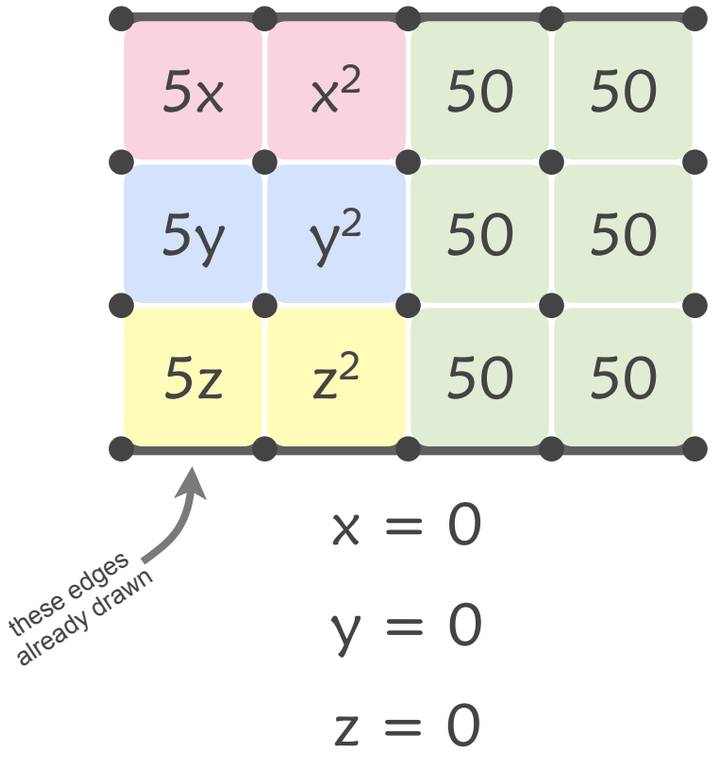
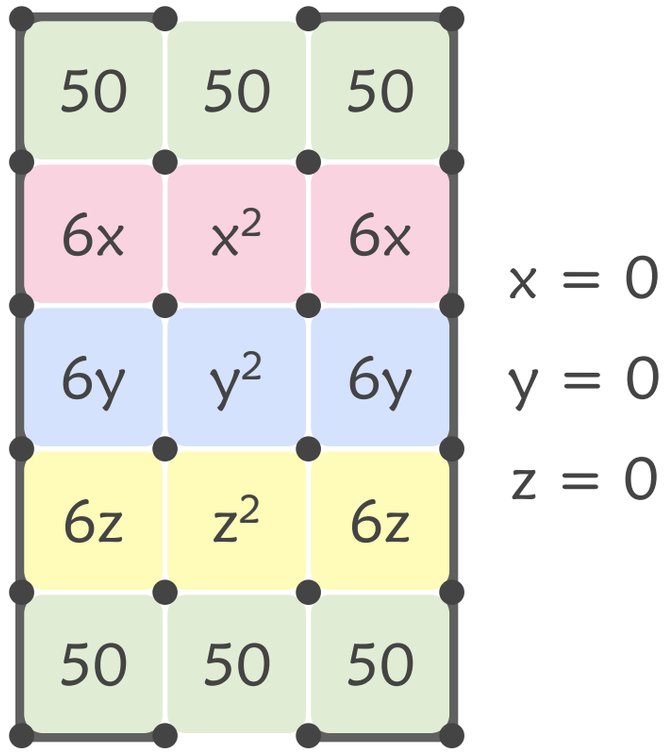
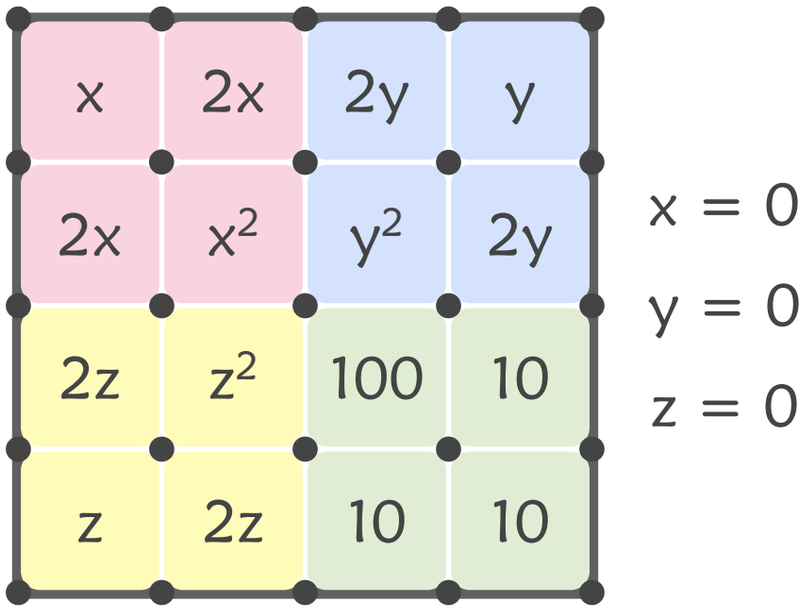
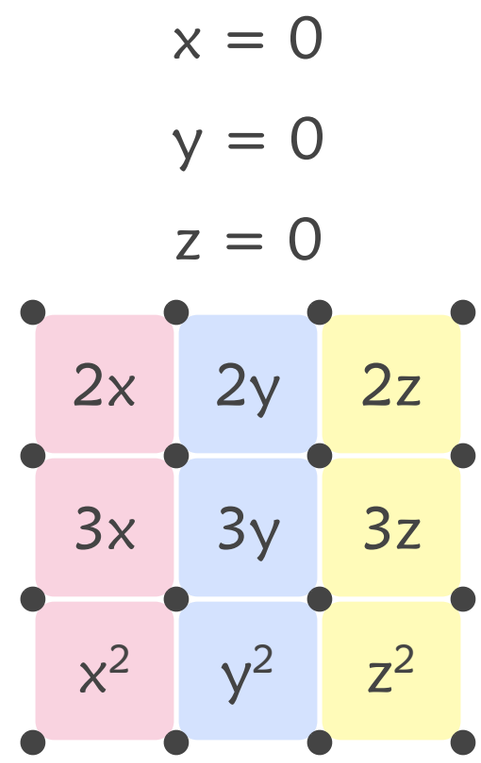
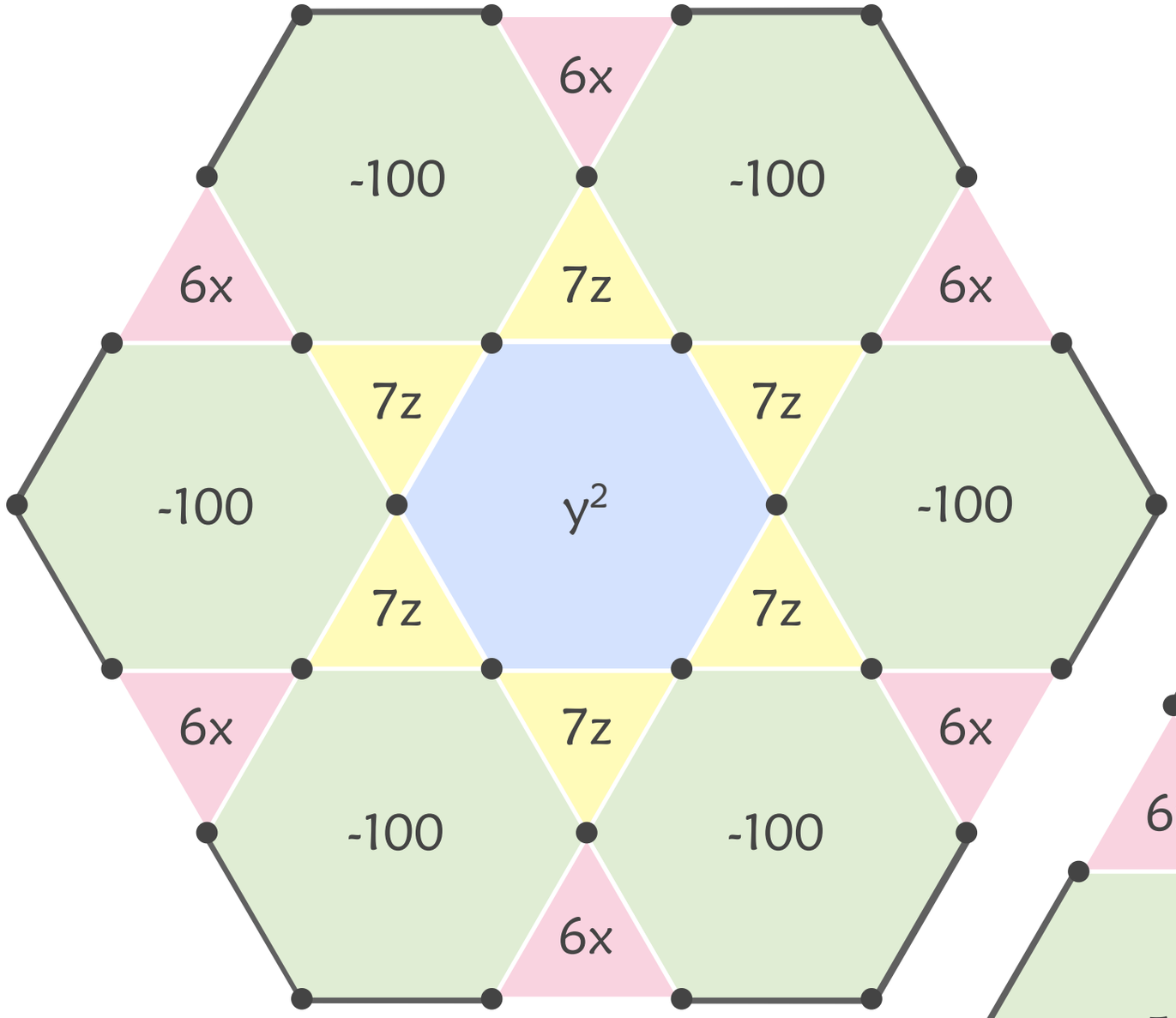
4) The winner is the person with the highest score (or the least negative score.)







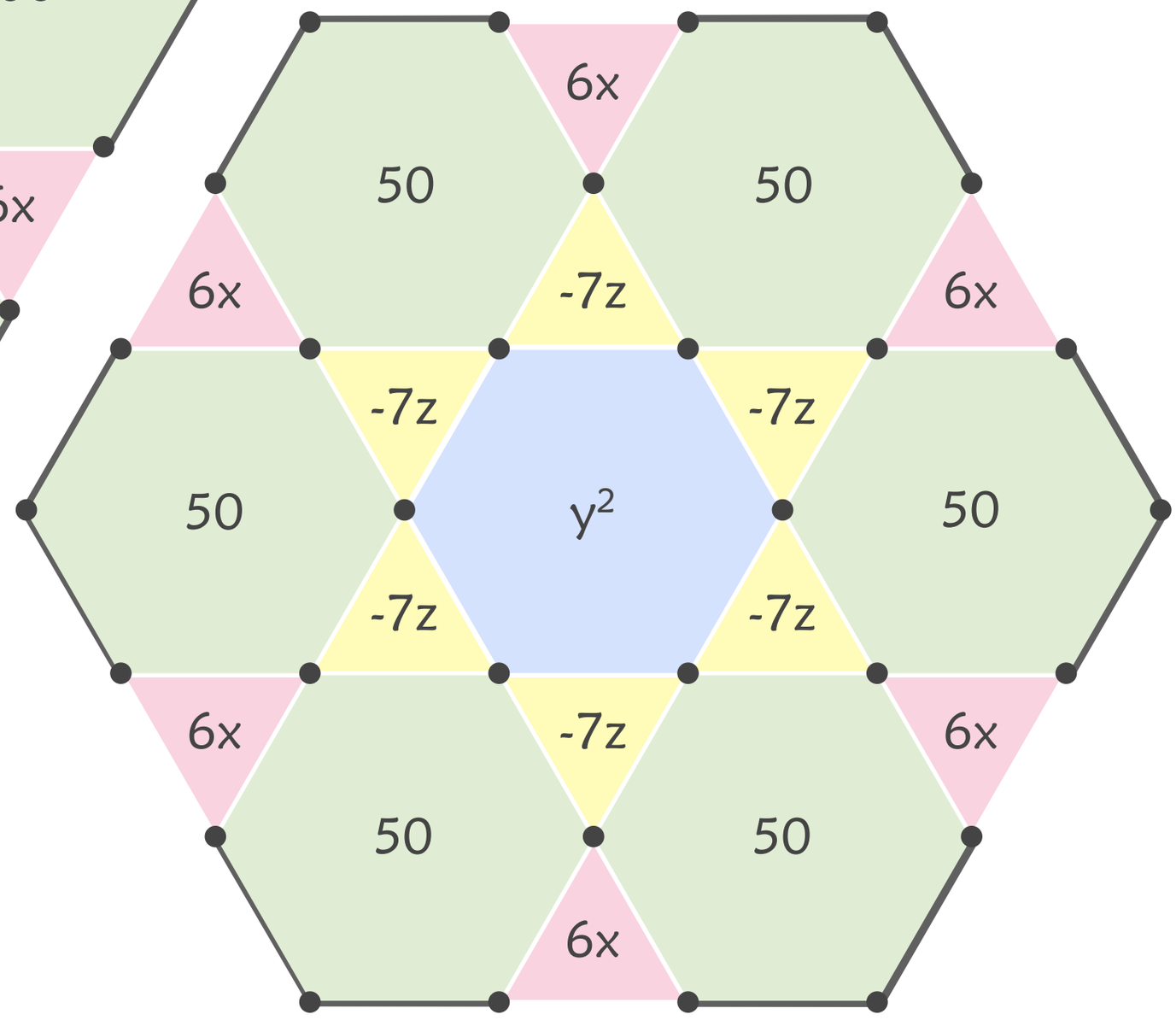




x = 5

y = 5

z = 5



x = 5

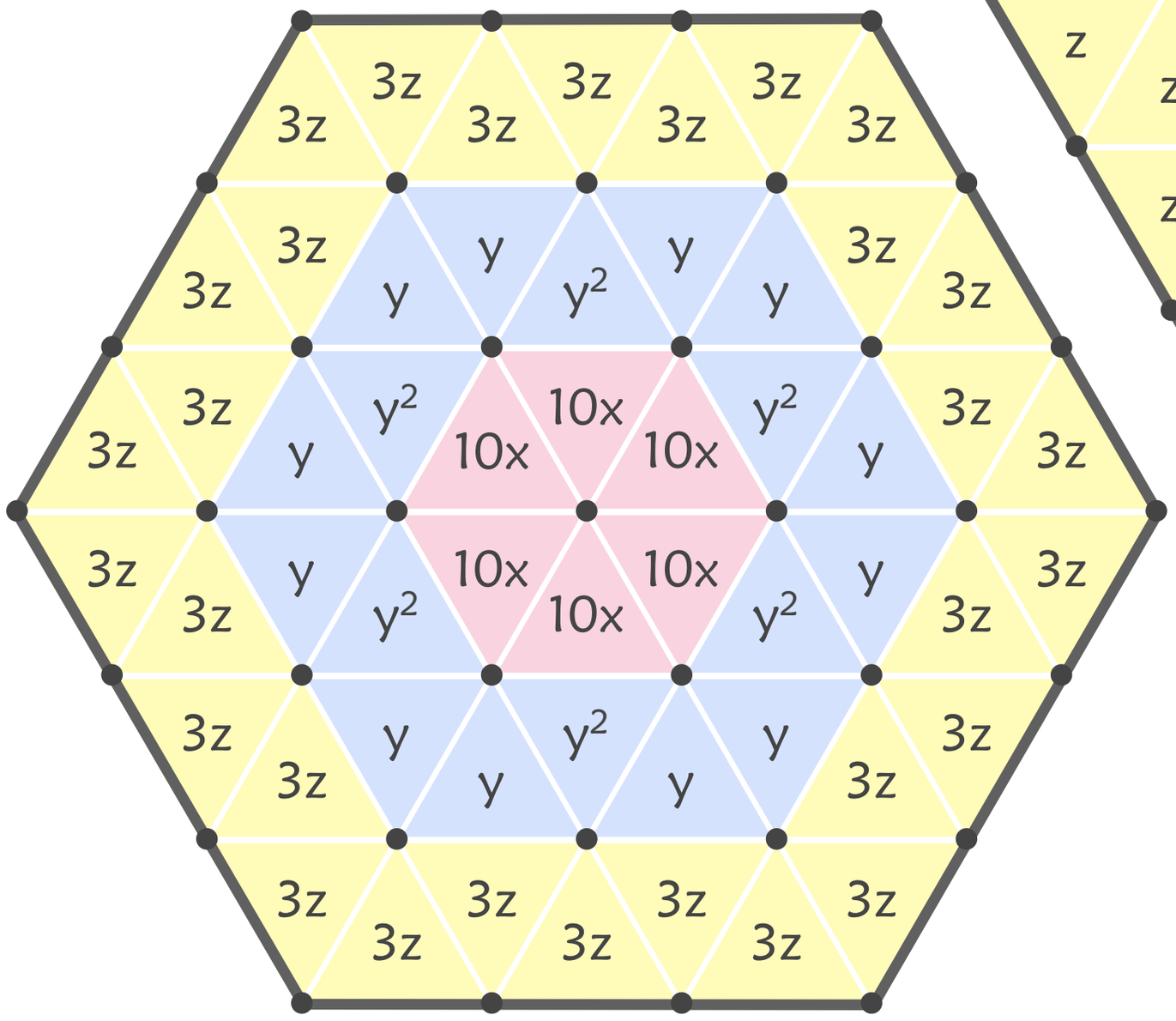
y = 5

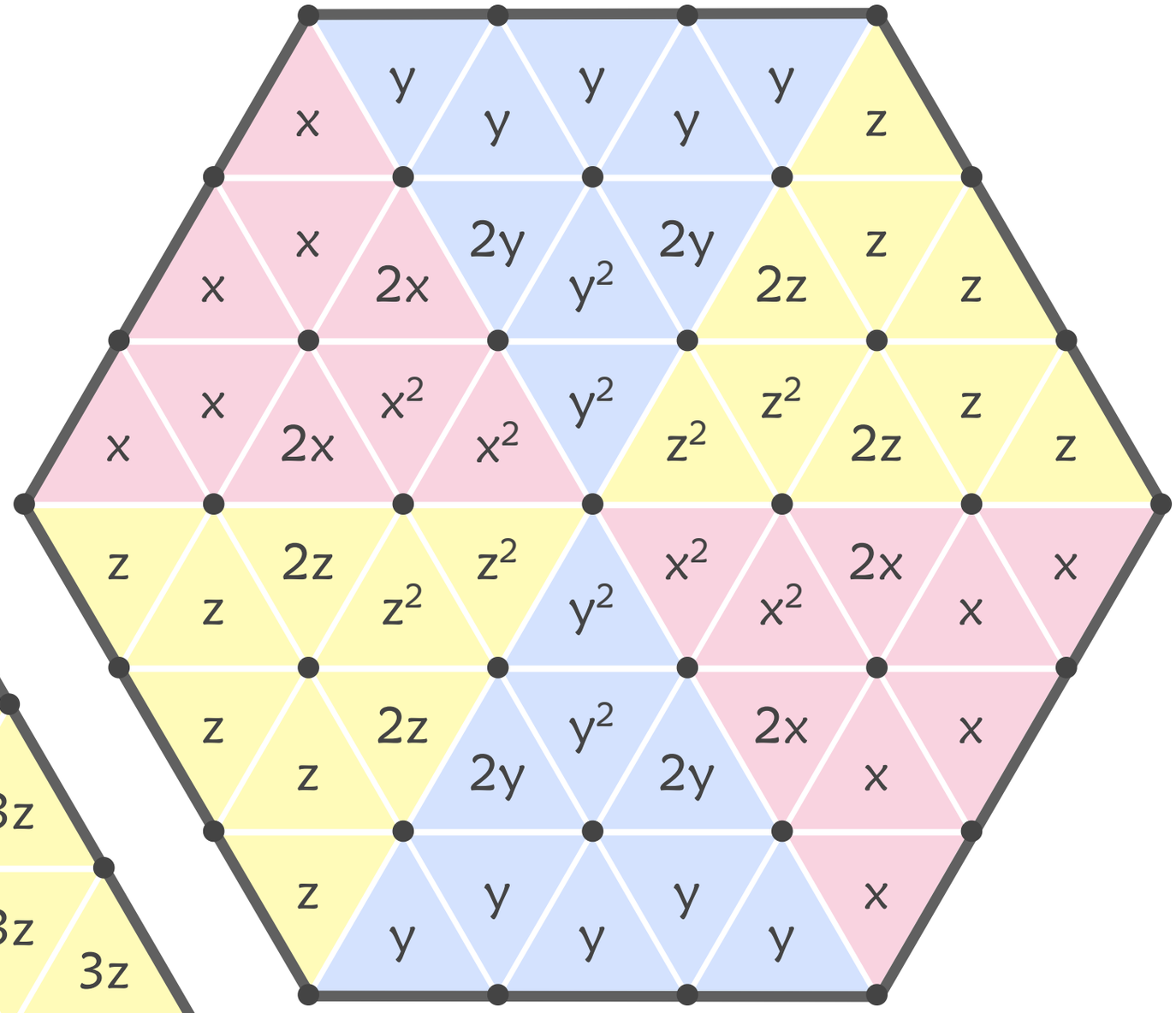
z = 5

x = 1

y = 0

z = -1





x = 1

y = 0

z = -1

Dots and Boxes xyz

This is ordinary dots and boxes except:

1) When you win a box, its value is often determined by a variable x, y or z. Example: a box labelled 4z is worth 60 if z = 15.

2) Once during the game you may skip adding a line and change the value of a variable by ±1. A variable that has been changed cannot be changed again.

3) The game is immediately over once all the boxes are filled. Variables cannot be changed after the boxes are all filled.

4) The winner is the person with the highest score (or the least negative score.)

y	y	x^3	x^2	x
y^2	$-5z$	$-5z$	$-5z$	x
y^3	$-5z$	100	$-5z$	y^3
x	$-5z$	$-5z$	$-5z$	y^2
x	x^2	x^3	y	y

$x = 3$

$y = 4$

$z = 5$

y	y^3	$5z$	x^3	x
y^2	y^3	$5z$	x^3	x^2
$5z$	$5z$	100	$5z$	$5z$
x^2	x^3	$5z$	y^3	y^2
x	x^3	$5z$	y^3	y

$x = 3$

$y = 4$

$z = 5$

x	x^2
10	-10
y	y^2

$x = 3$

$y = 4$

$z = 5$

10	-10
z	z^2

This time you are increasing or decreasing by ±1 instead of ±10.

Dots and Boxes xyz

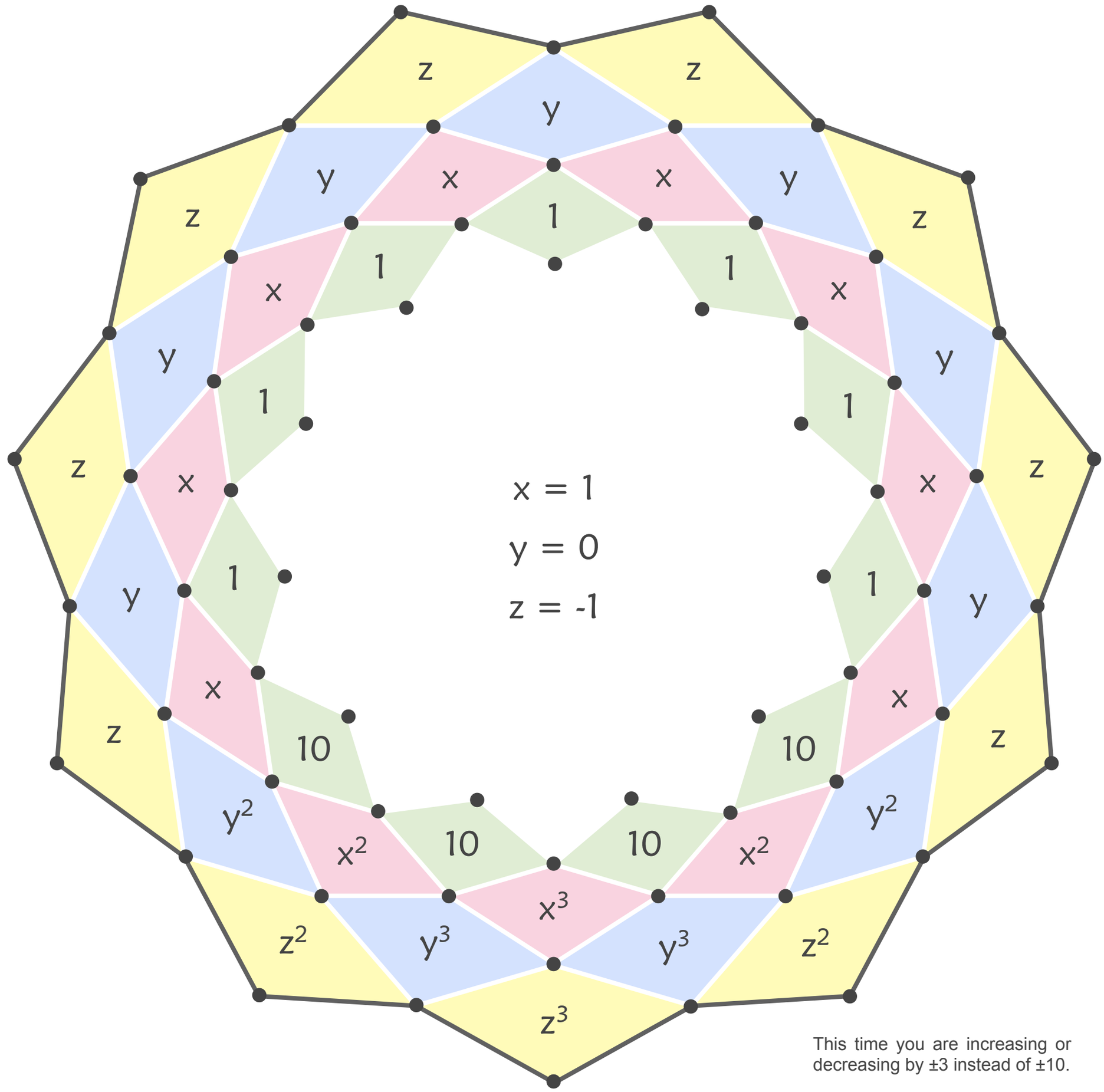
This is ordinary dots and boxes except:

1) When you win a box, its value is often determined by a variable x, y or z. Example: a box labelled 4z is worth 12 if z = 3.

2) Once during the game you may skip adding a line and change the value of a variable by ±3. A variable that has been changed cannot be changed again.

3) The game is immediately over once all the boxes are filled. Variables cannot be changed after the boxes are all filled.

4) The winner is the person with the highest score (or the least negative score.)

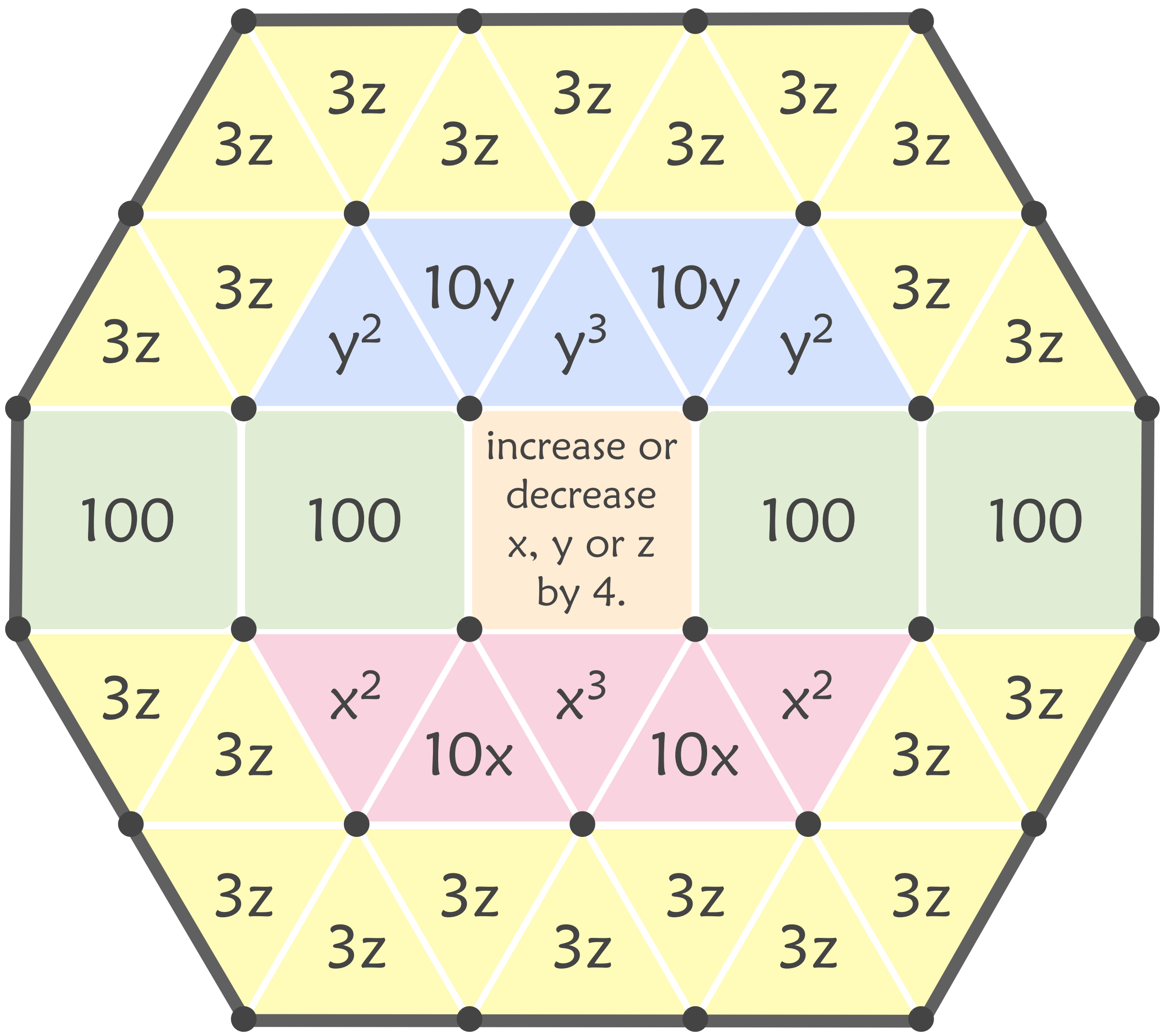


This time you are increasing or decreasing by ±3 instead of ±10.

$x = 2$

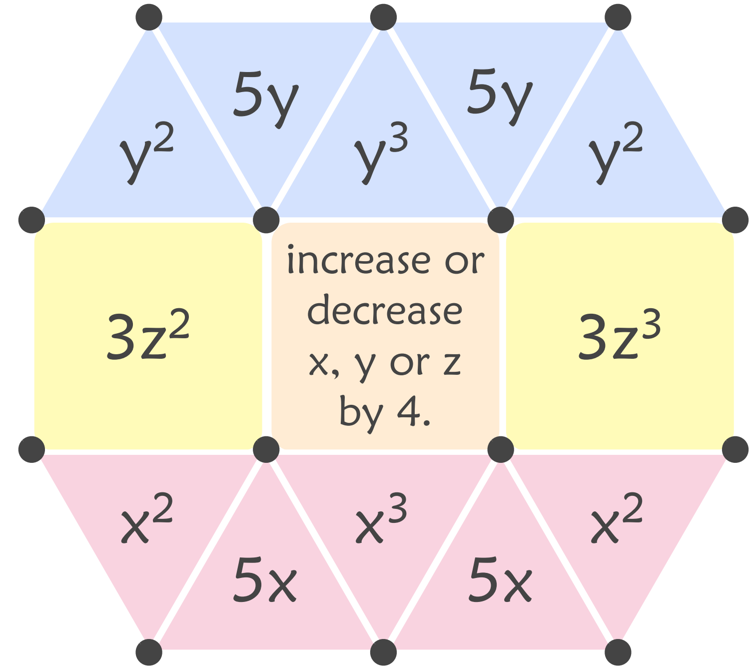
$y = 1$

$z = 0$



The central square allows the person who completes it to immediately increase or decrease x, y or z by 4. This cannot be done for a variable that has already been changed. It cannot be done if this is the last square to be filled. After filling in the square, the player still has another turn.

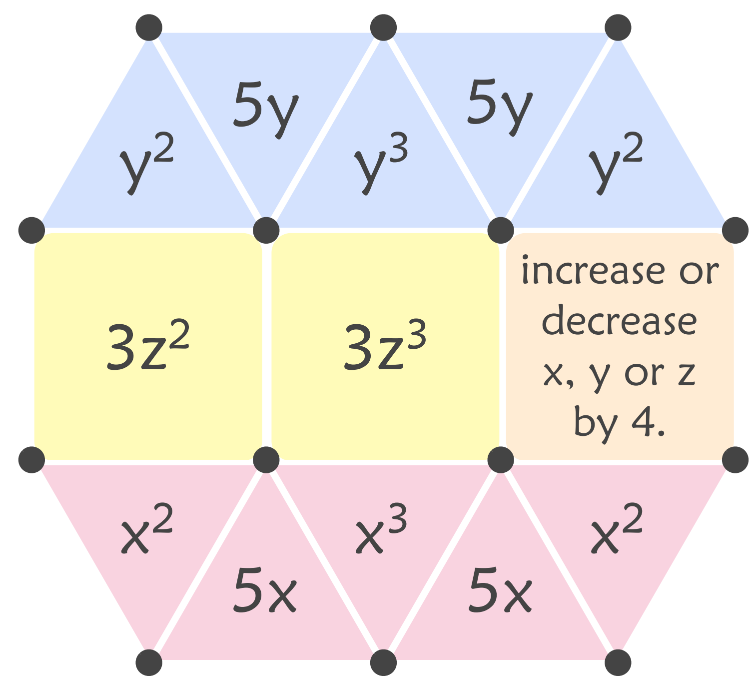
This time you are increasing or decreasing by ±3 instead of ±10.



$x = 2$

$y = 1$

$z = 0$



$x = 2$

$y = 1$

$z = 0$

Dots and Boxes xyz

This is ordinary dots and boxes except:

1) When you win a box, its value is often determined by a variable x, y or z. Example: a box labelled 4z is worth 60 if z = 15.

2) Once during the game you may skip adding a line and change the value of a variable by ±10. A variable that has been changed cannot be changed again.

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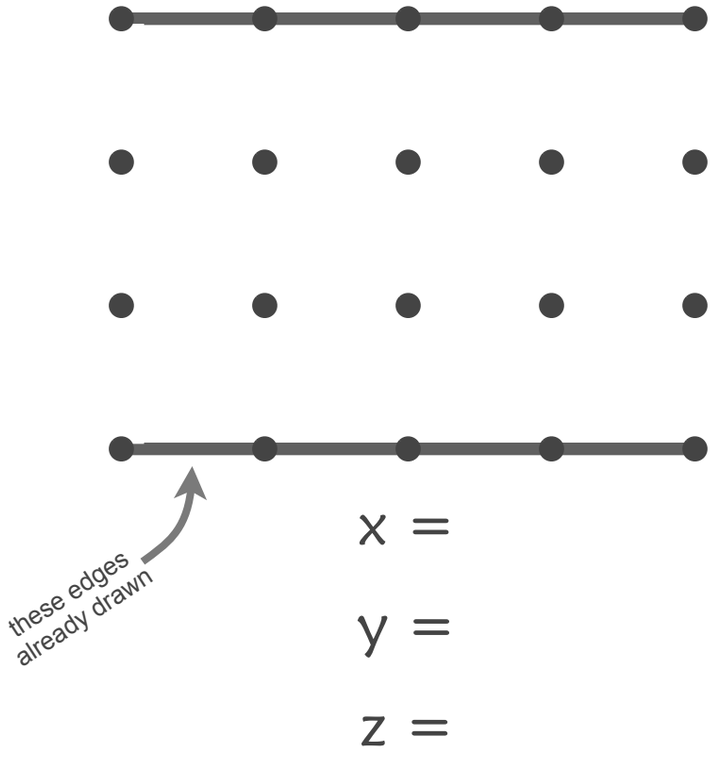

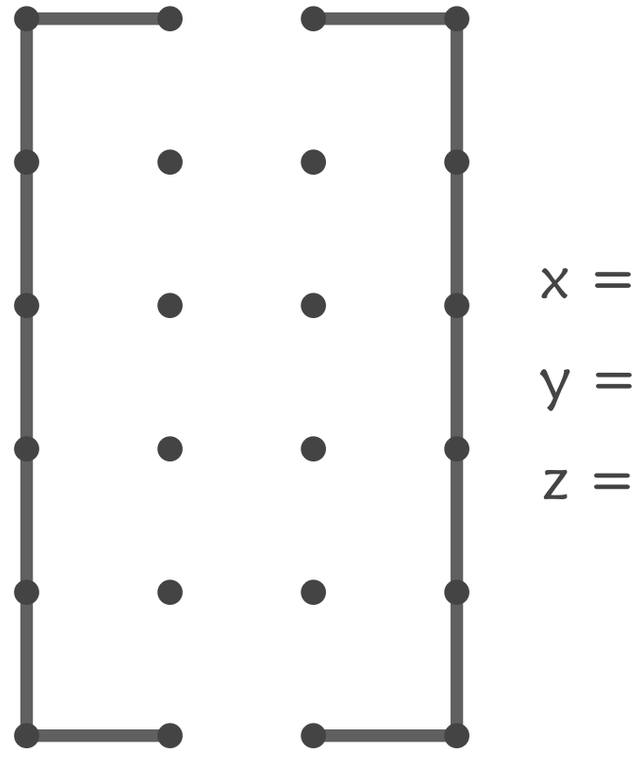

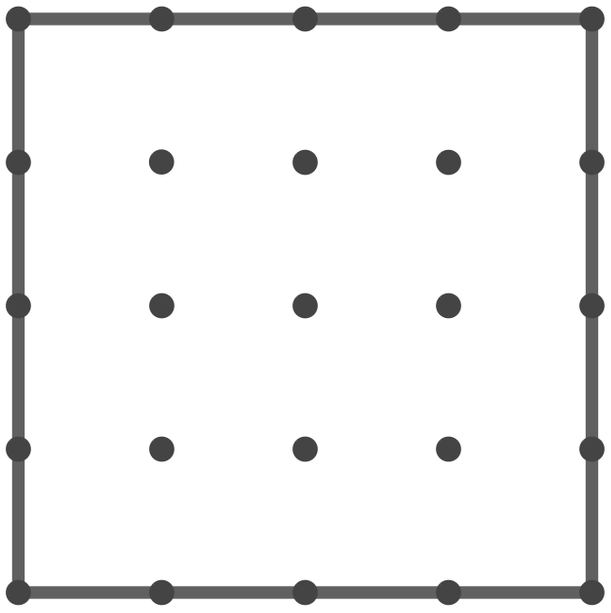

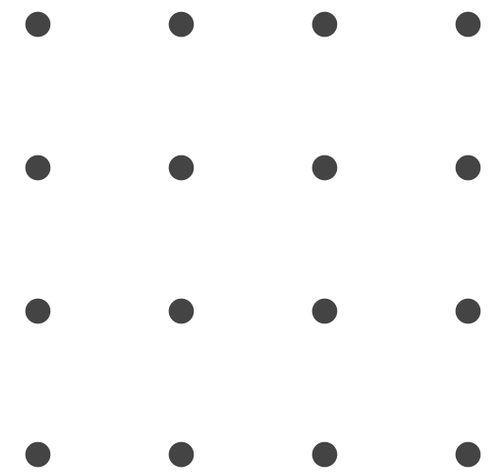

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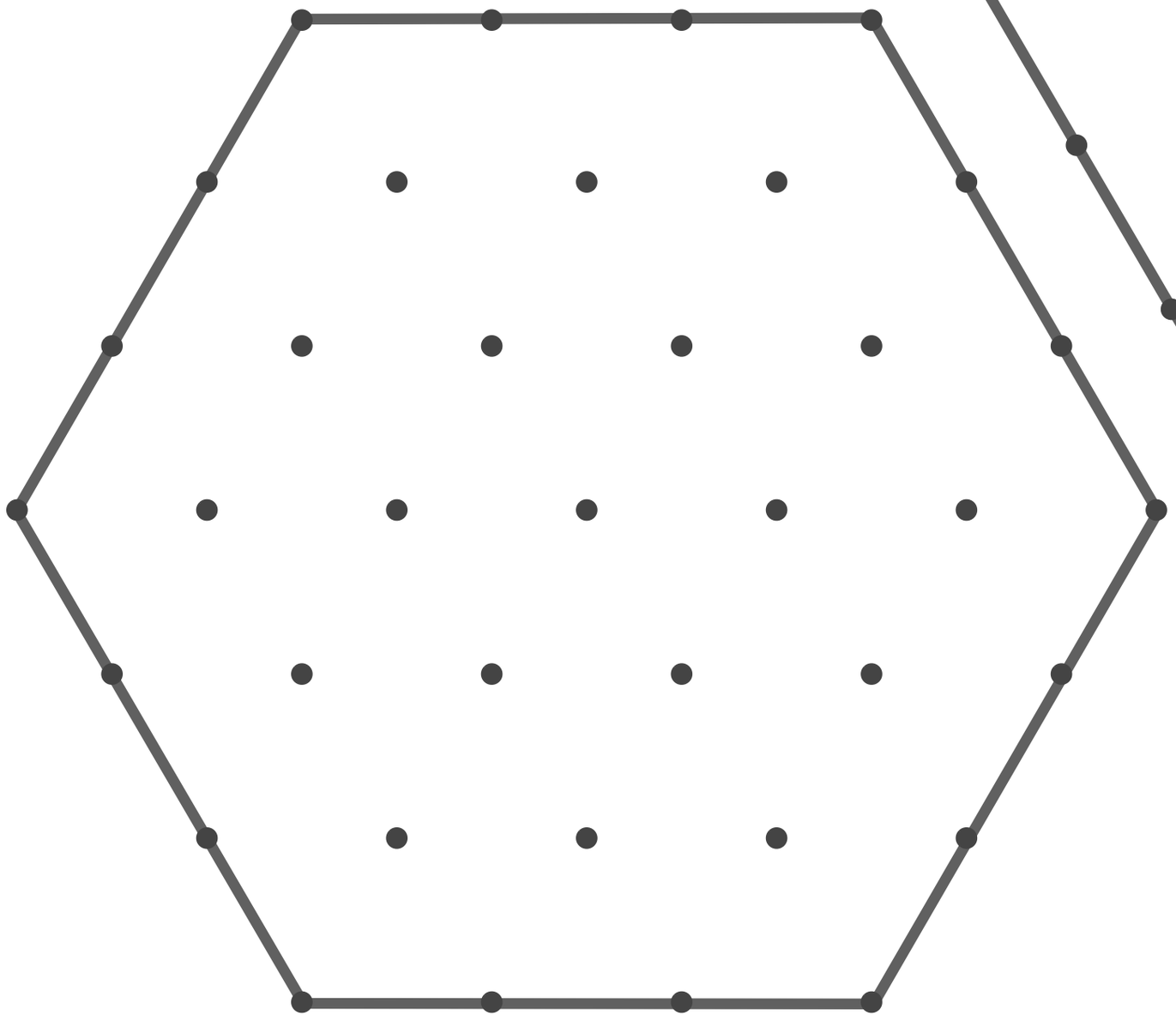
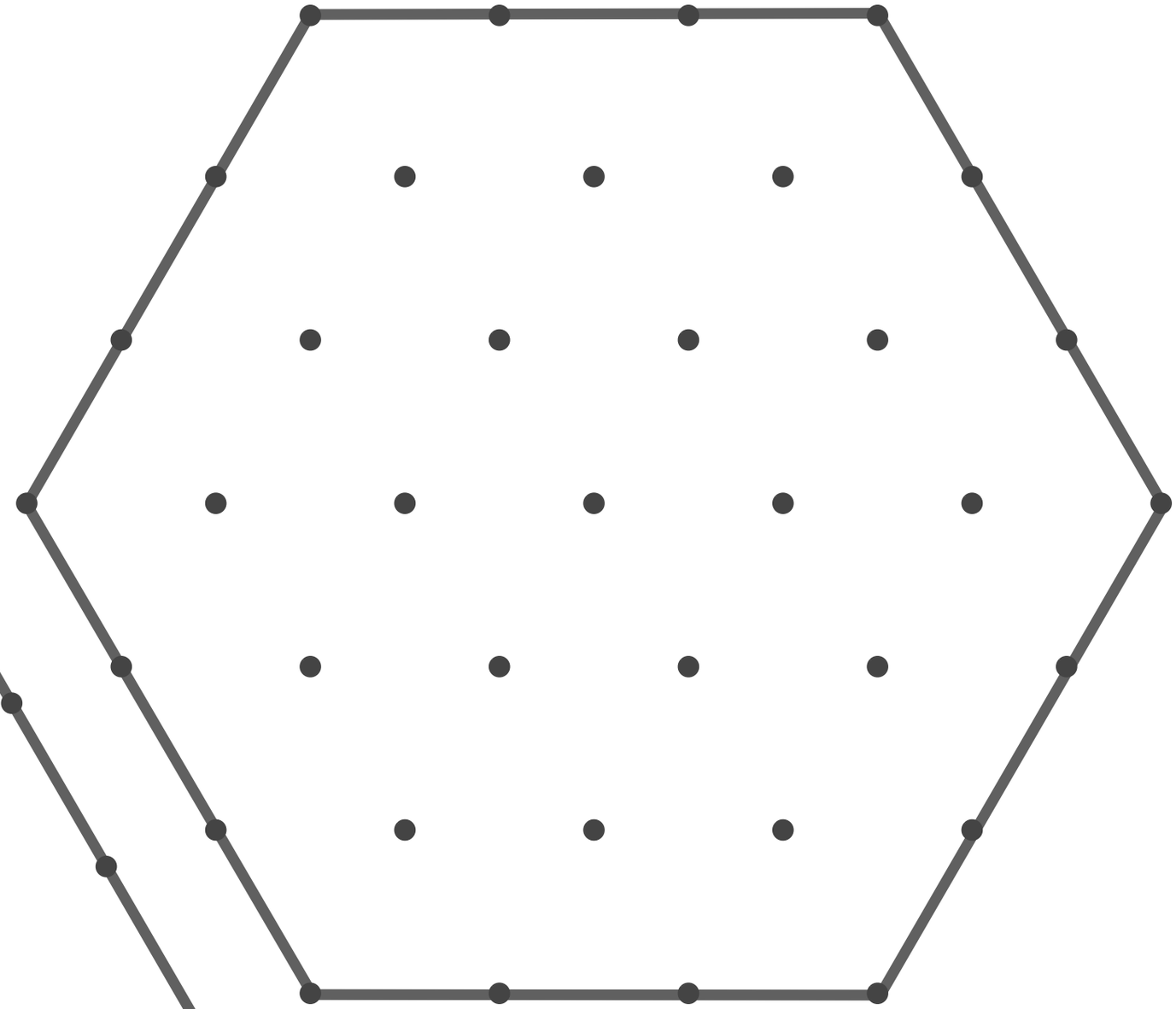
y =

z =





x =

y =

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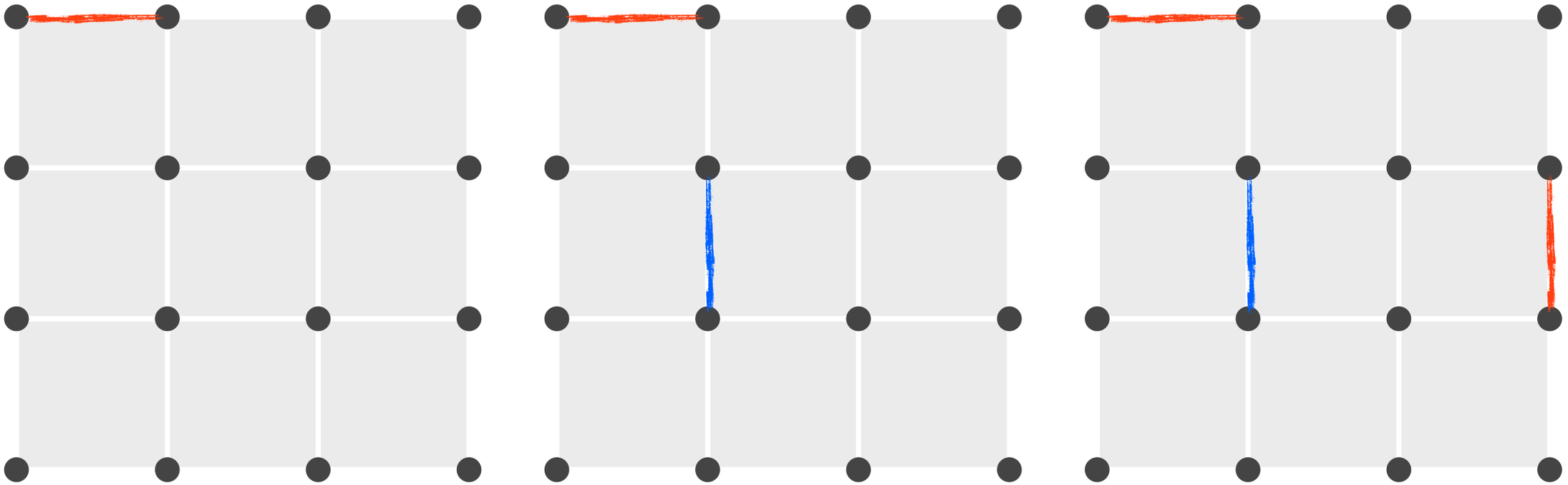
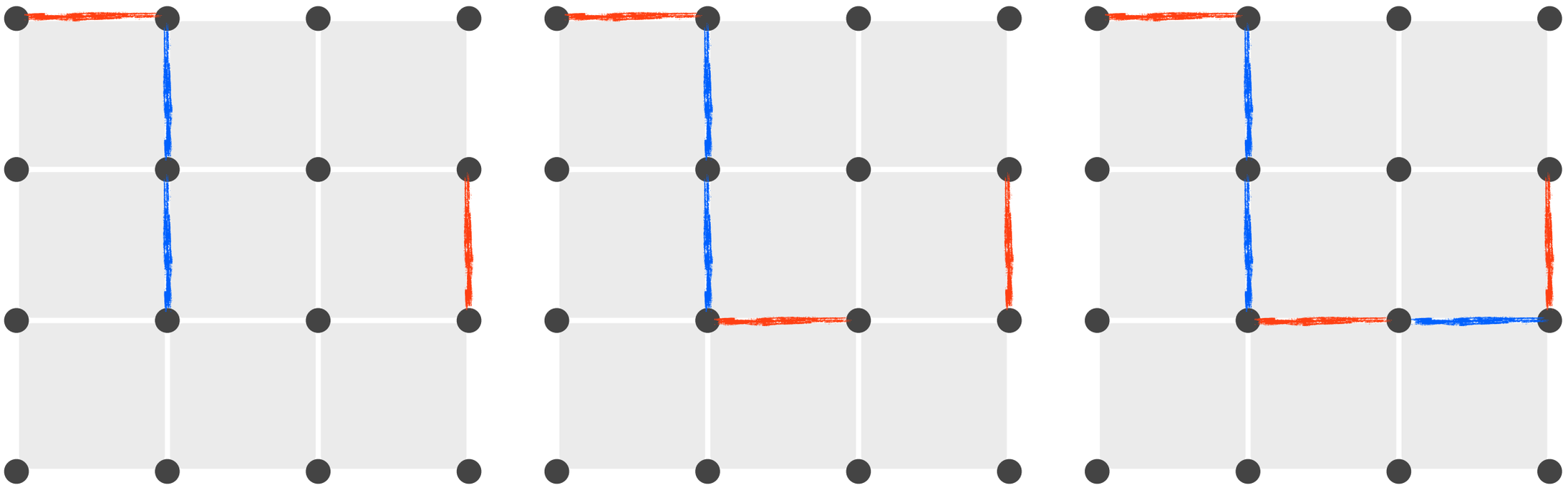
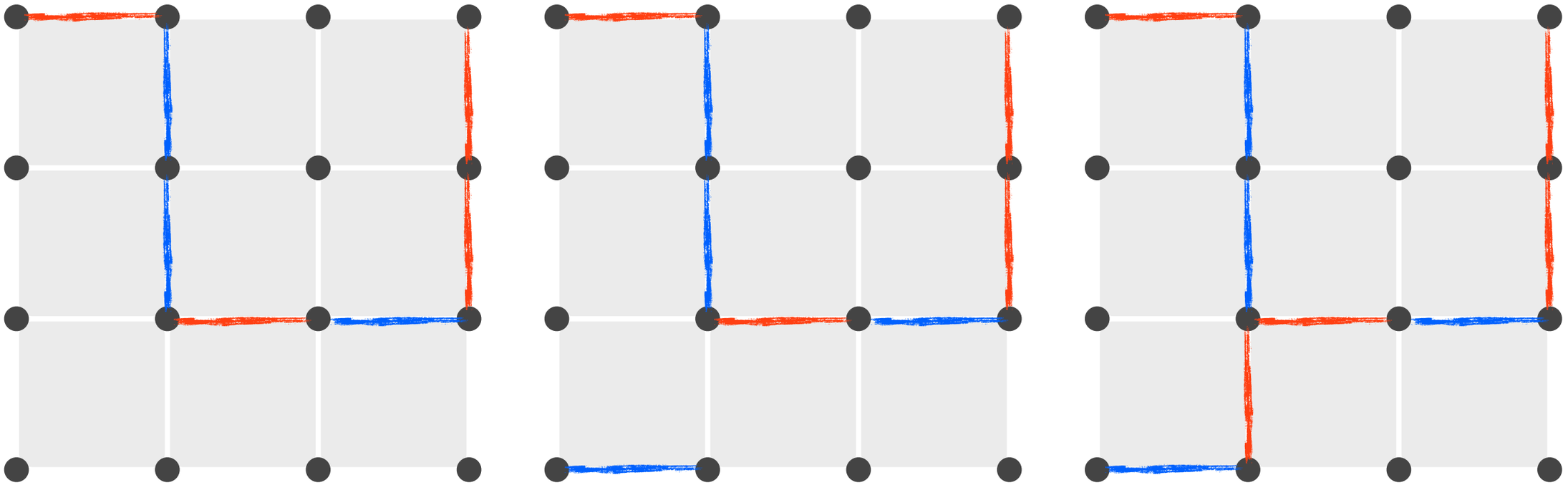


In the standard game of dots and boxes, players take turns joining two horizontally or vertically adjacent dots by a line. A player that completes the fourth side of a square (a box) colors that box and must play again. When all boxes have been colored,the game ends and the player who has colored more boxes wins.
To play this game online go to http://www.math.ucla.edu/~tom/Games/dots&boxes.html





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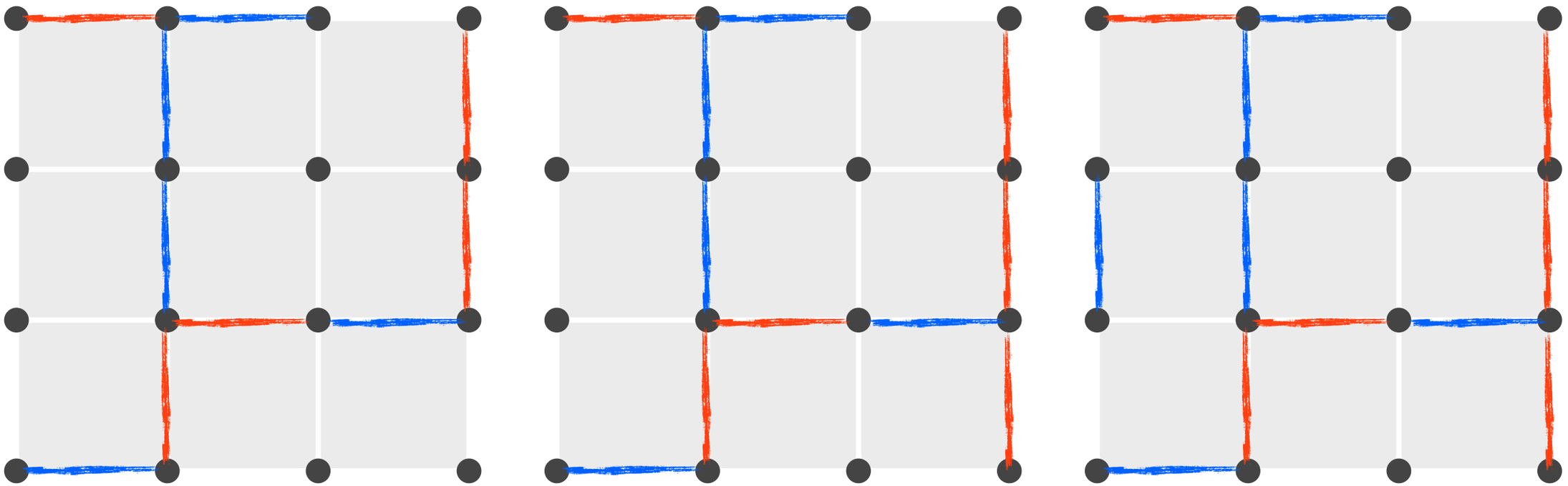

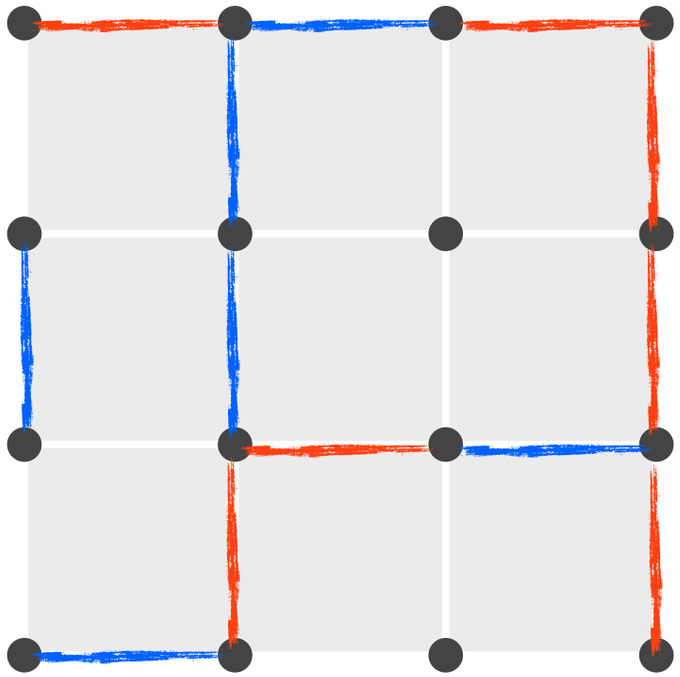

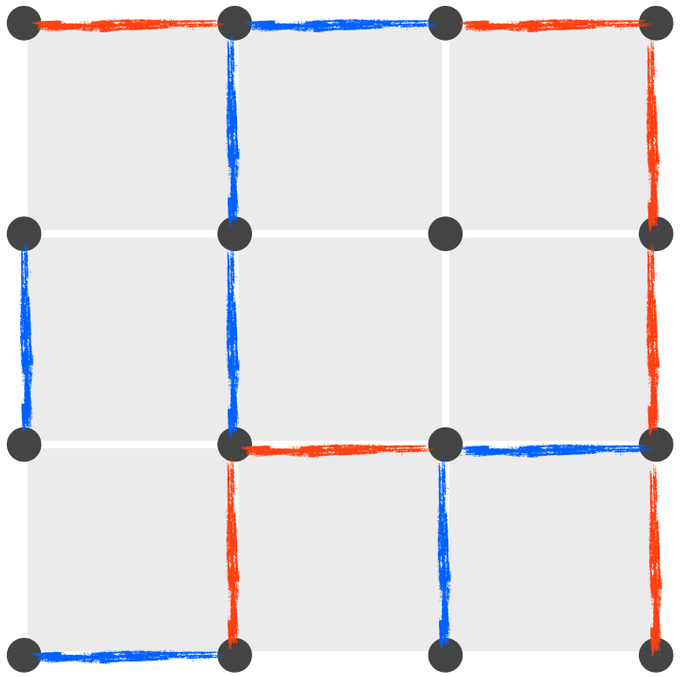

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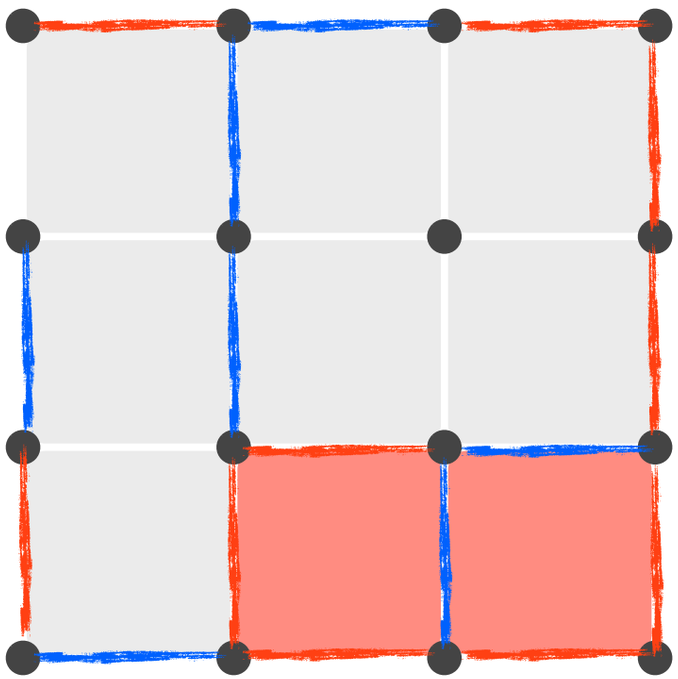

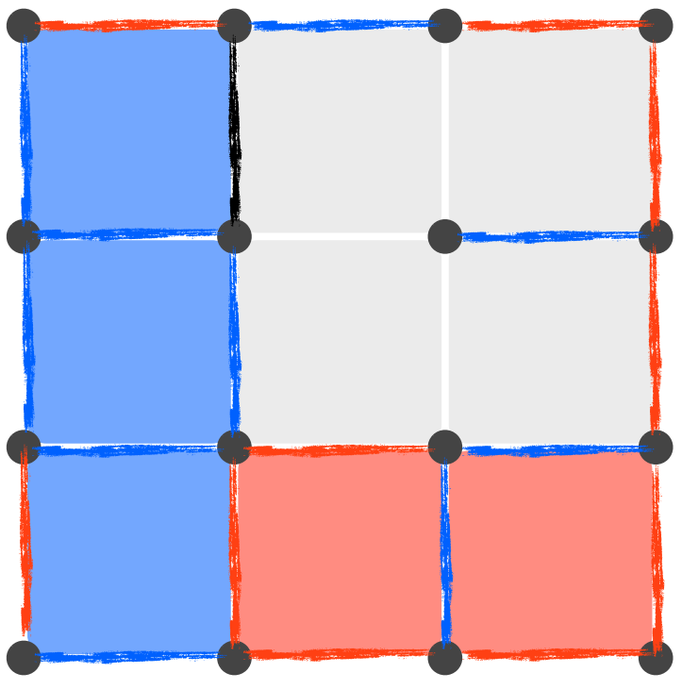

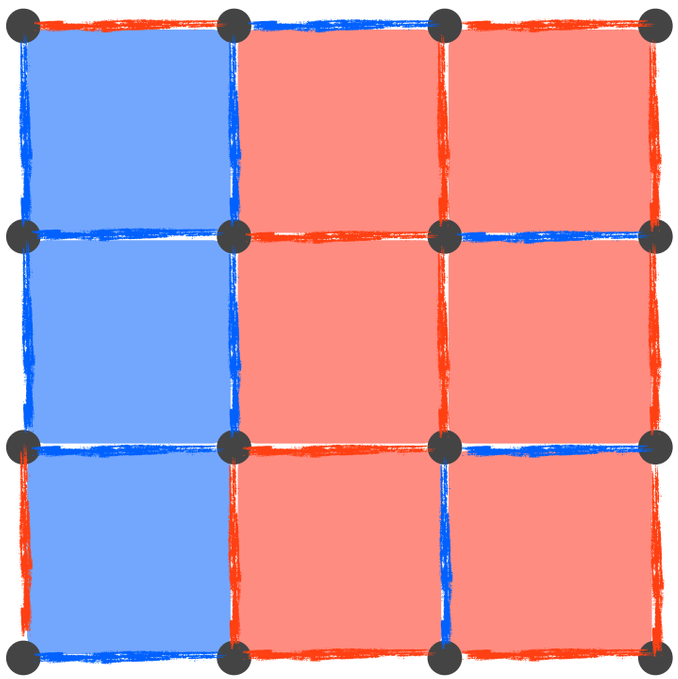

red wins 3:6

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 them 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