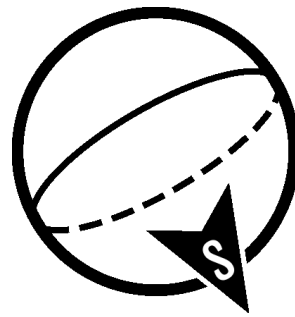


# Puzzle: Removing counters

Ten counters are arranged into the shape of an equilateral triangle. What is the smallest number of counters that can be removed so that no equilateral triangle of any size can have its corners marked out by the centres of the remaining counters? Can you generalise your answer for any triangle of counters?



**The South**  
Oct 15th, 2023

## Prove: crazy keypads



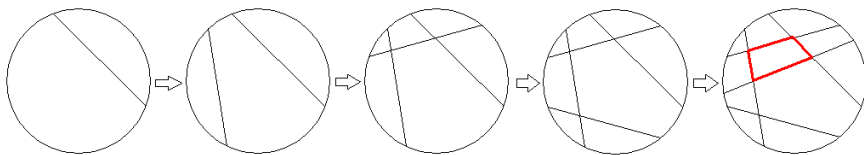
On a standard calculator keypad like the one shown (left), any four-digit number with no zeroes typed in a rectangular or parallelogram shape is evenly divisible by 11. (e.g. 1782, 4268, 5984, 6523). How come?

Now try taking three digits in order from any row, column, or main diagonal and append the same three digits in reverse order (e.g., 951159). The resulting number will always be evenly divisible by 37. Why?

## Discuss: Pizza slicing

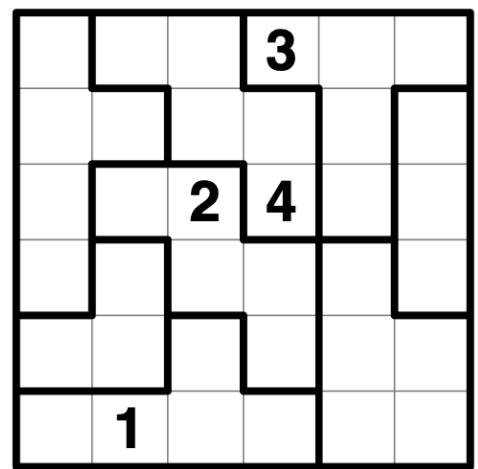
Source: [tinyurl.com/pizza-cut](https://tinyurl.com/pizza-cut)

On average, how many times must a round pizza be randomly sliced to get a piece with no crust? i.e. What's the expected number of random chords made by connecting two uniformly random points on the perimeter of the circle, until you get a polygon? In the below example, it takes five cuts:



## Play: Suguru

Fill each cage with unique digits, counting up from 1 to the size of the cage. Squares that are adjacent vertically, horizontally and diagonally must never contain the same number.

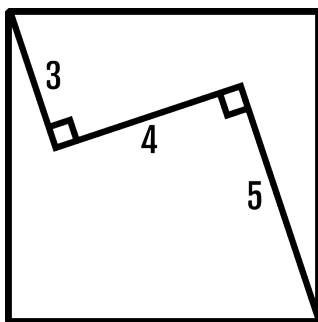


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More at [crazydad.com/play/suguru](https://crazydad.com/play/suguru)

## Solve:

Determine the area of the square



## Maths art: Elementary cellular automata

Make fascinating patterns on some square grid paper.

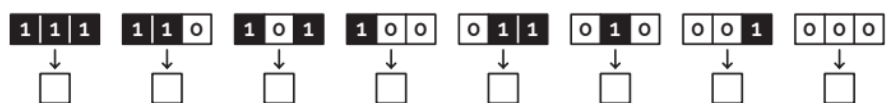
Read the Chalkdust article for more info: [tinyurl.com/cell-automata](https://tinyurl.com/cell-automata)

An elementary cellular automaton is a (1-dimensional) row of cells that evolves over successive "generations" according to simple rules. The rule to determine the state of a cell in the next row / generation depends only on its current state and the state of its two immediate neighbours.

To bring a cell automaton to life, start with a random seed: for your first row, randomly assign **1 = on** or **0 = off** to the squares at the top of a page of grid paper, shading the "on" cells and leaving the "off" cells blank.

Next you will need a set of rules. Pick a number between 0-255, convert it to binary and write it out in the 8 boxes below, again so 1 = on and 0 = off.

These will be the rules that determine subsequent rows of your pattern.



Now work your way along each cell in the next row of your grid, referring to the three cells immediately above it and shading the cell or leaving it blank according to the appropriate rule. To fill in the end cells, imagine that the row is surrounded by an infinite sea of zeros. Some rule sets are much more chaotic than others so enjoy playing around to see what you discover.

## Mystery middle digit



Seven different digits are placed in a row. The product of the first three digits, the product of the middle three digits, and the product of the last three digits are all equal.

What is the middle digit in the row?