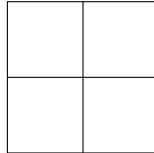


# $2 \times 2 \times 2 \times 2$ four-dimensional Quarto

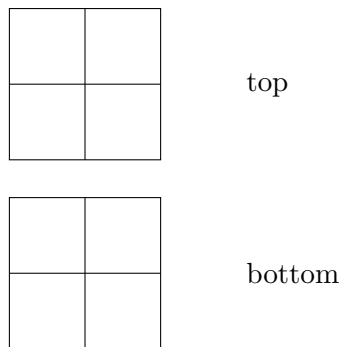
Peter Rowlett

21st April 2020

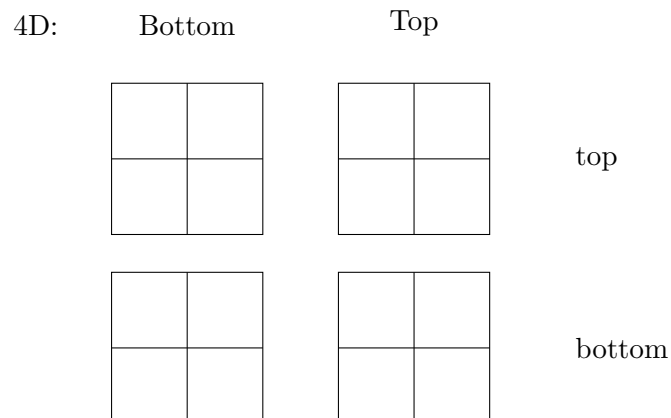
Consider a game played on a  $2 \times 2$  grid.



Imagine playing on a  $2 \times 2 \times 2$  cube grid. Rather than making a cube, we could simply draw three  $2 \times 2$  grids on top of each other and remember the links between the layers exist, so the upper right space on the 'top' grid is above the upper right space on the 'bottom' grid.



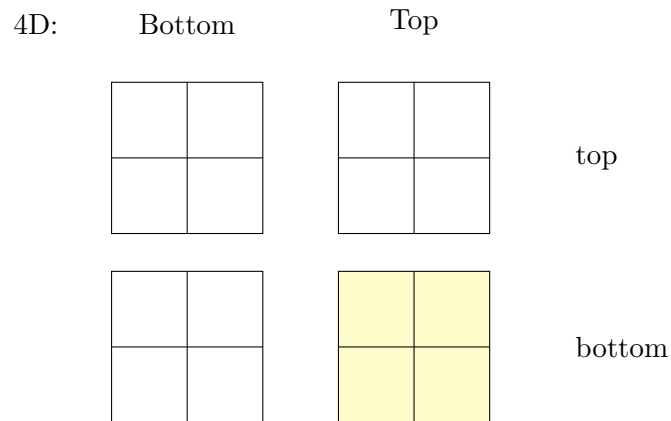
To play in a fourth dimension, we 'simply' imagine another cube stacked on top of that one *in the fourth dimension*.



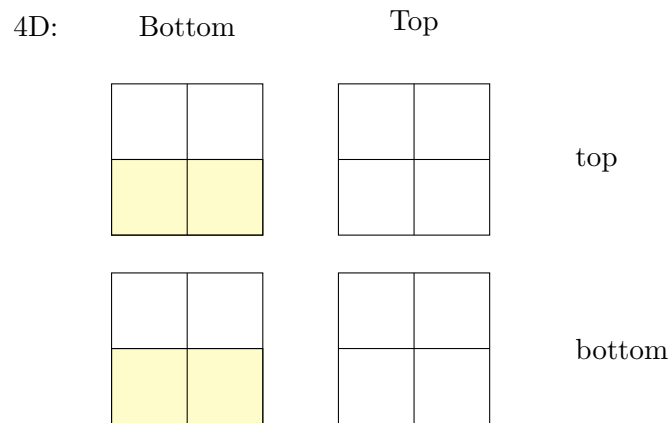
# Ways of winning

Examples are given of different types of winning position. The list is not exhaustive.

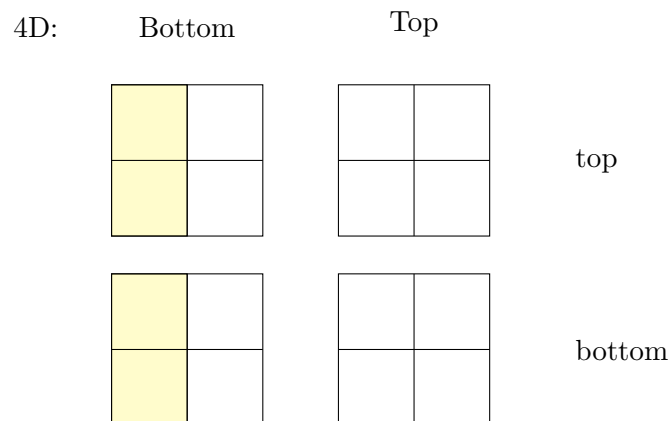
1. A single plane. e.g.



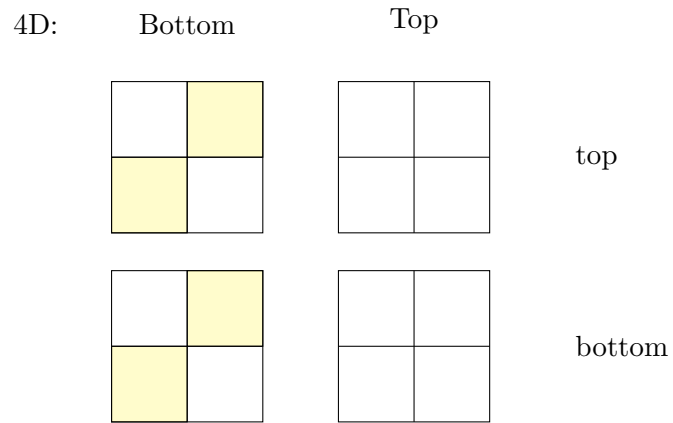
2. Two lines in the same position in two planes in the same cubes. e.g.



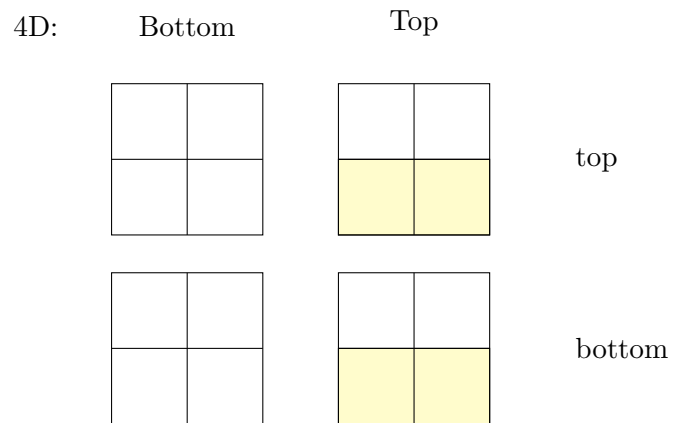
or



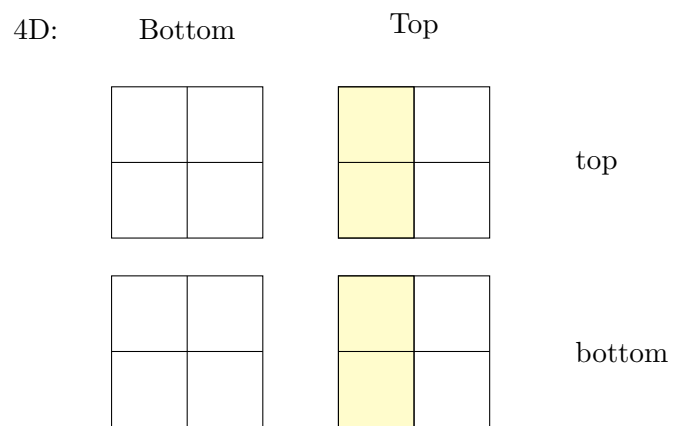
or



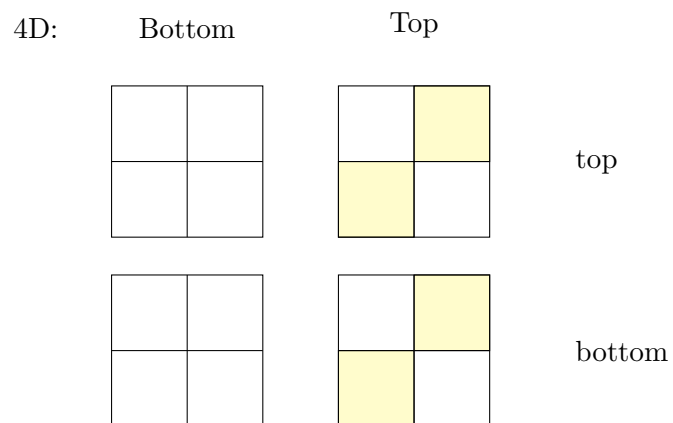
or



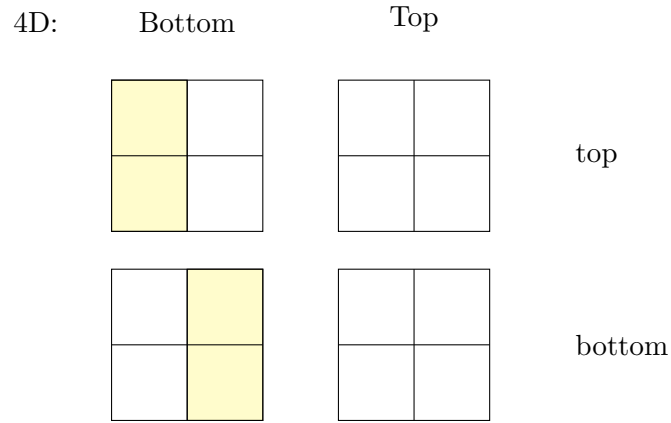
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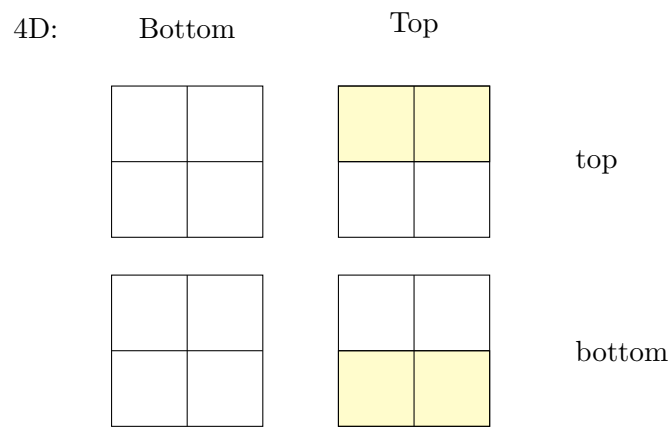
or



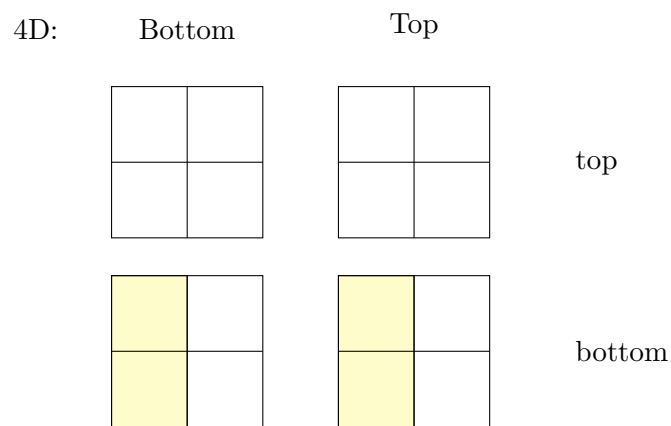
3. upright diagonals



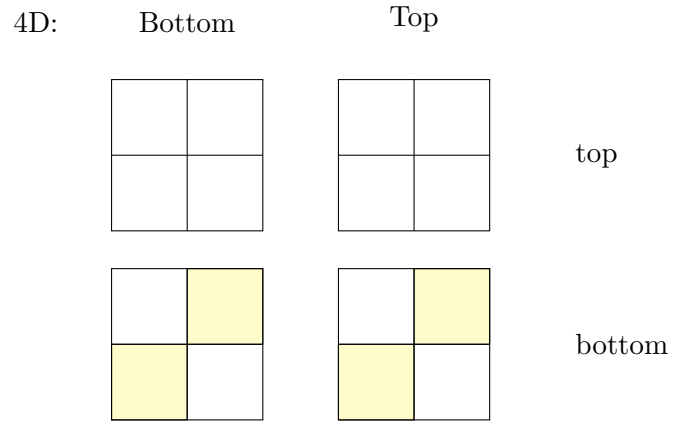
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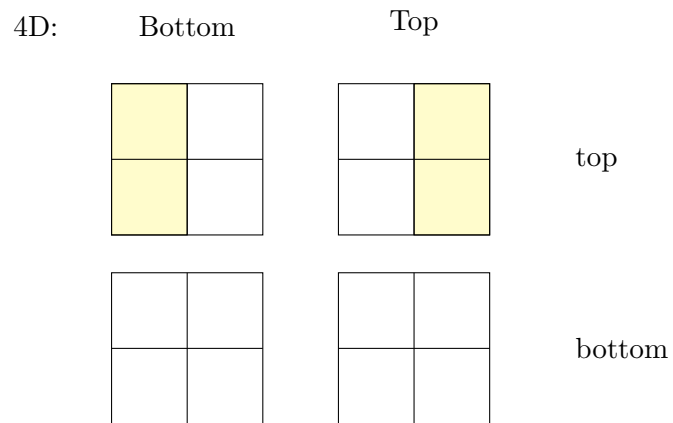
4. 4-dimensional goodness



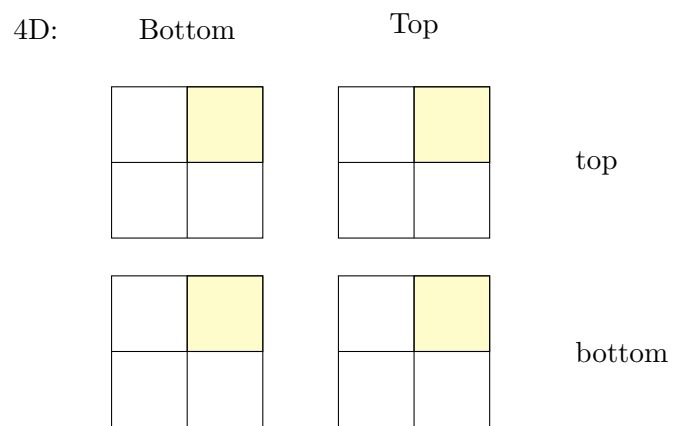
or



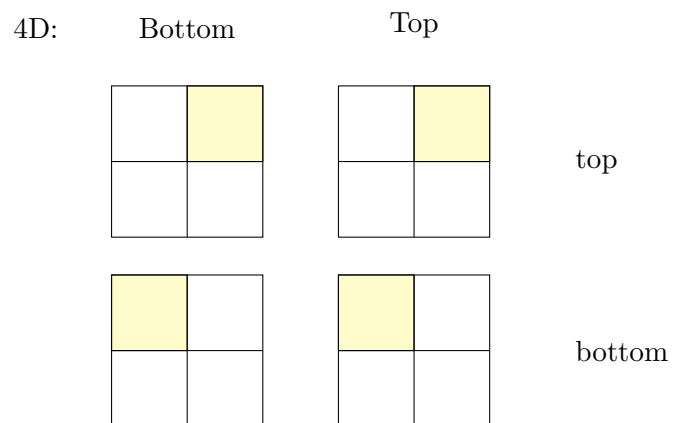
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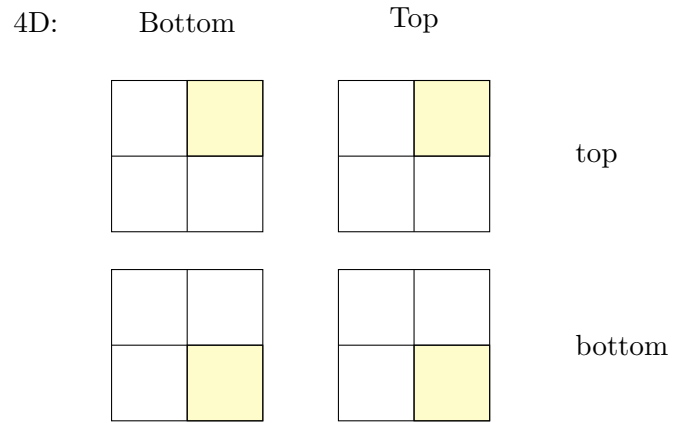
or



or



or



Based on 4-Dimensional Noughts and Crosses by Dr David Butler, 2012 <https://www.adelaide.edu.au/mathsllearning/play/4DOXRules.pdf>.