

# Aspect ratio test slide

This should  
be a square.

If this is a  
square, these  
slides have  
been stretched  
from  
4:3 to 16:9.

# MENACE

Matthew Scroggs



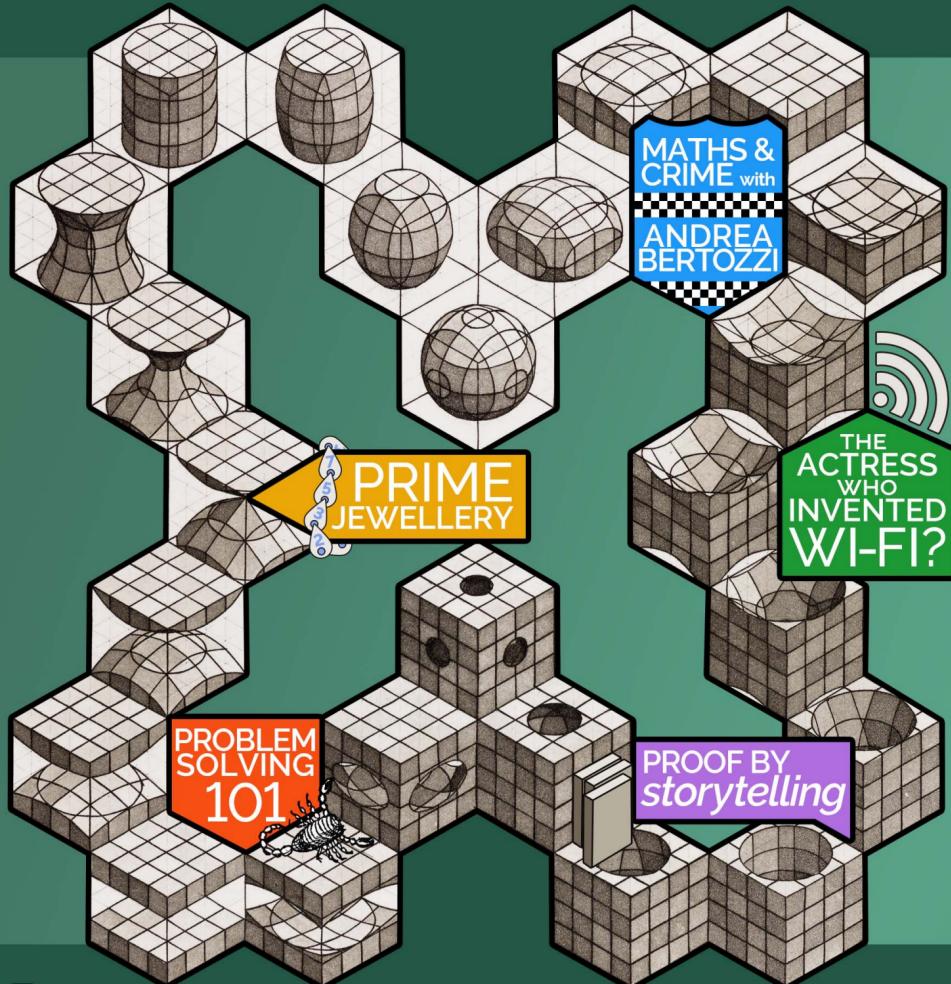
@mscroggs

[mscroggs.co.uk](http://mscroggs.co.uk)

# chalkdust

A magazine for the mathematically curious

ISSUE 04 // AUTUMN 2016



PRIZE CROSSNUMBER + TOP TEN CHALK COLOURS  
WHAT'S HOT + WHICH MATHS BRANCH ARE YOU?

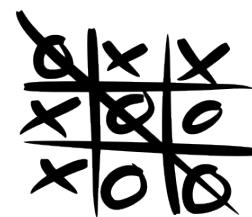
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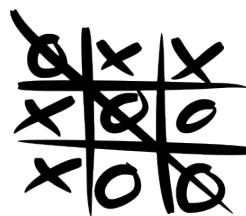
Write for us!  
Deadline for issue 05 articles  
is 3 December.

[contact@chalkdustmagazine.com](mailto:contact@chalkdustmagazine.com)

# Donald Michie

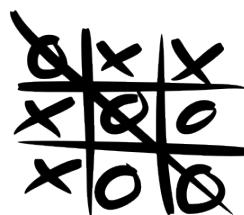


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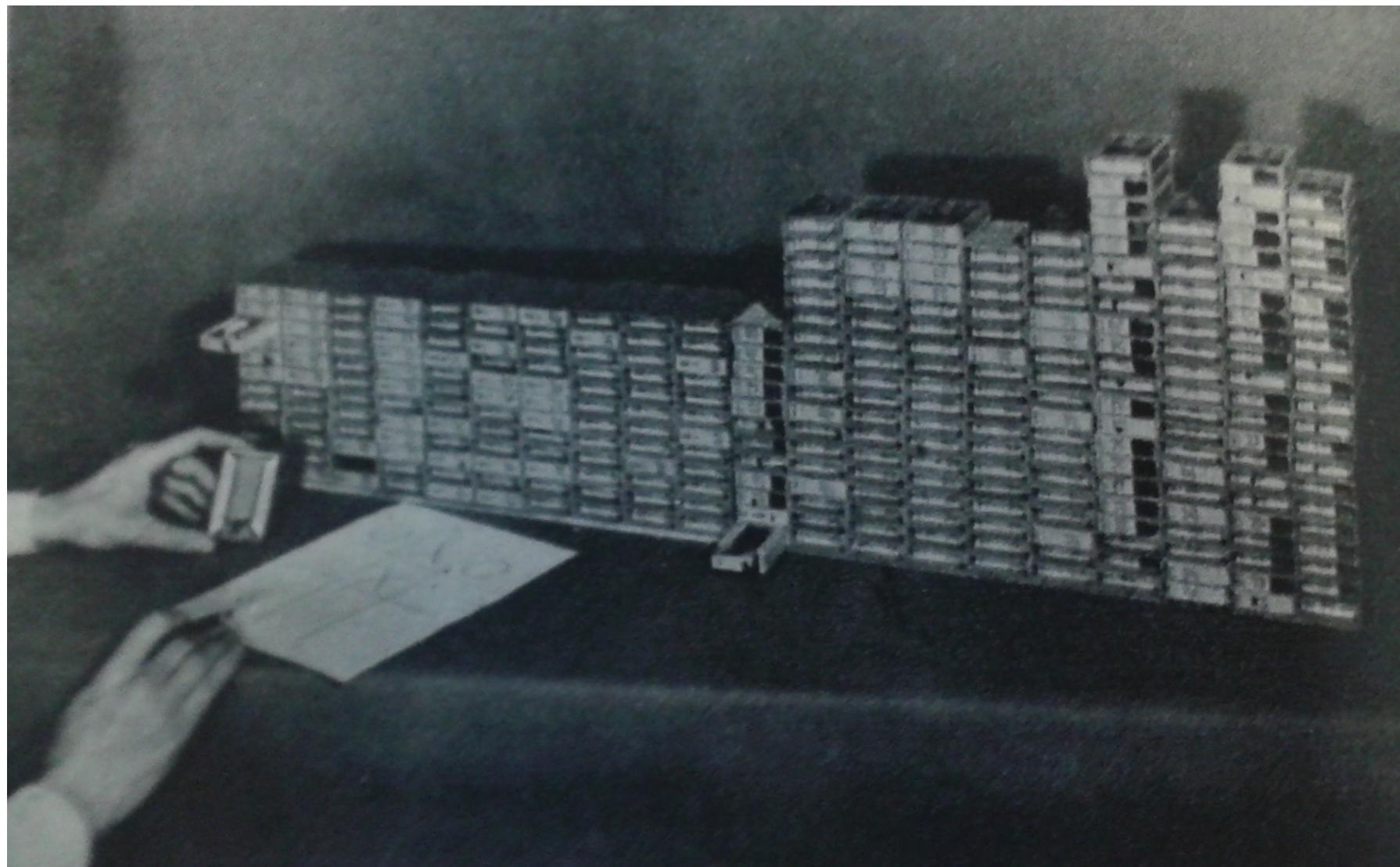
# MENACE

## Machine Educable Noughts And Crosses Engine

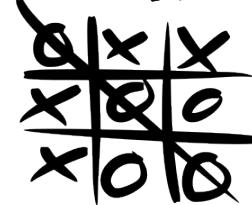
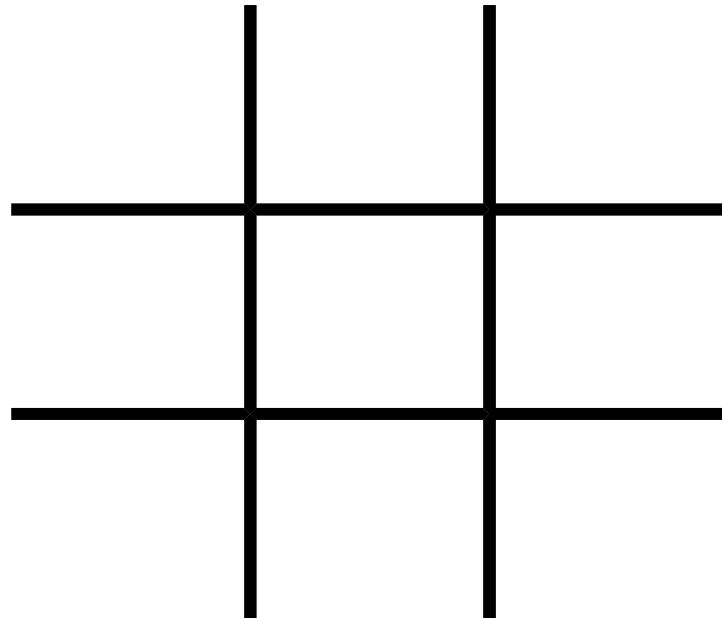


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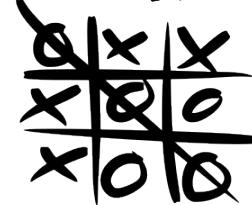
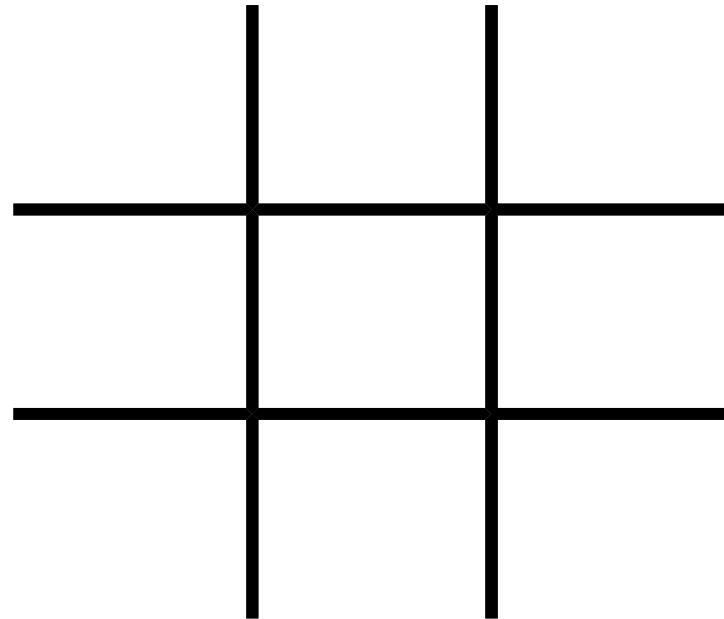
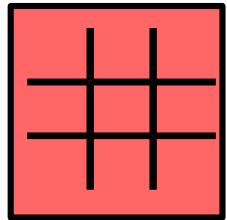
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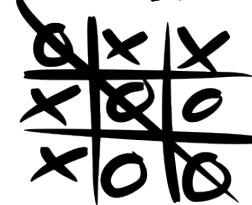
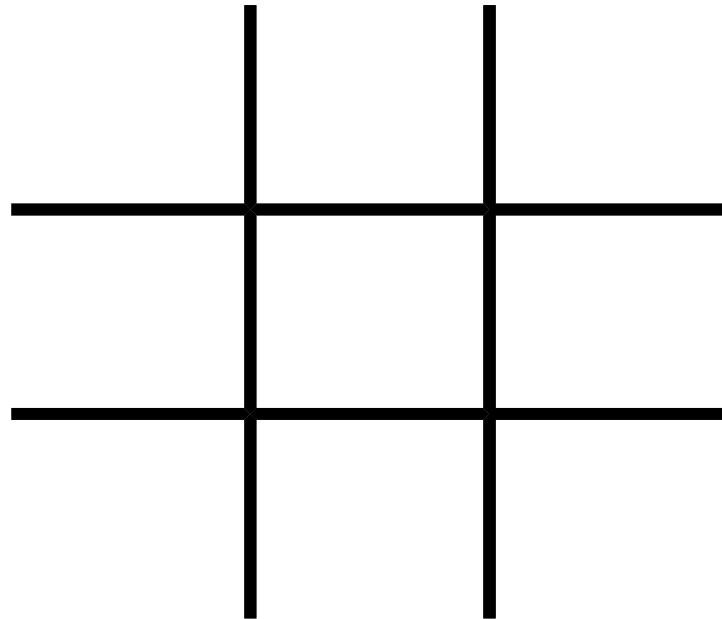
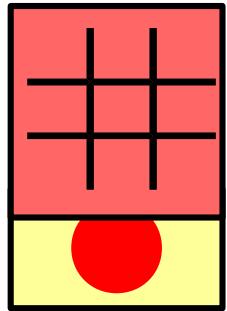
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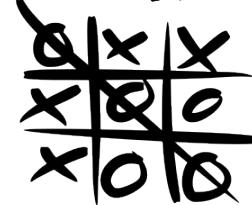
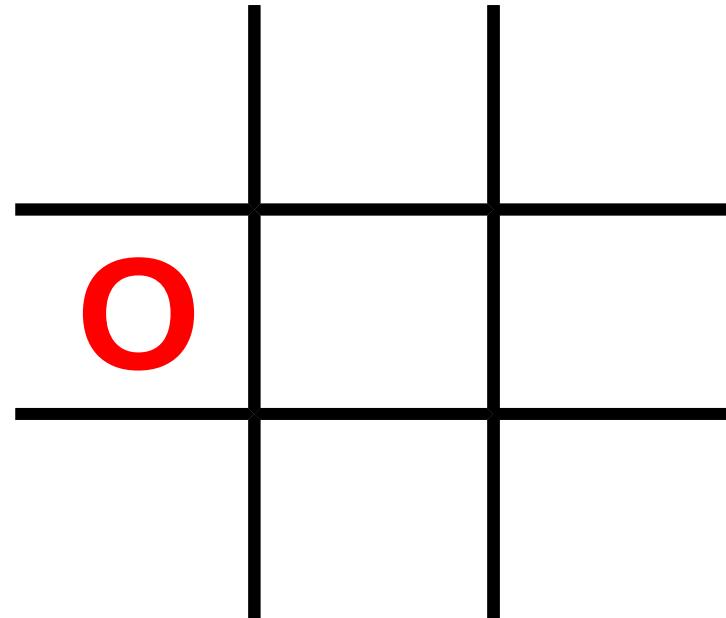
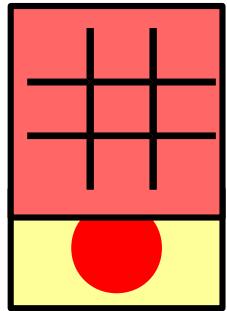
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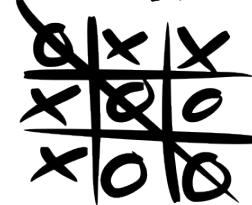
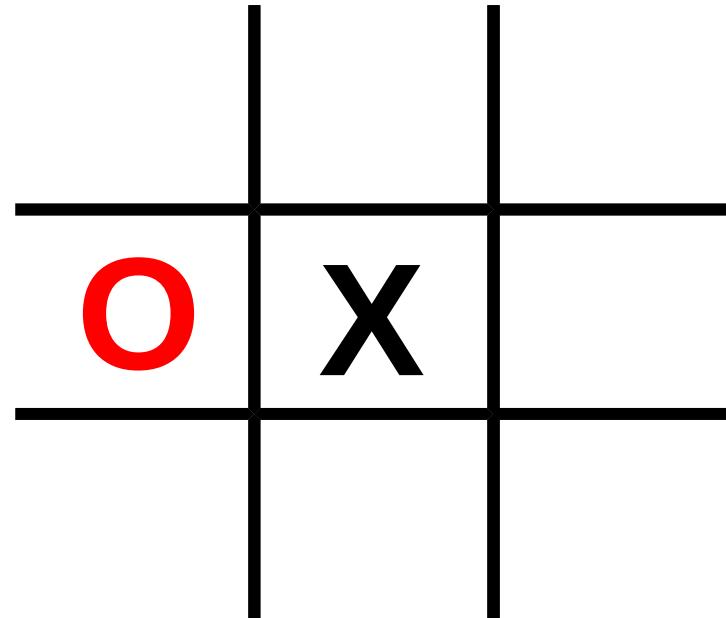
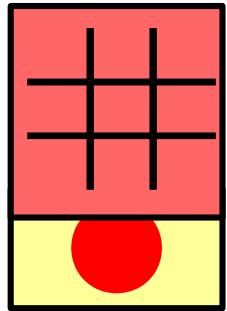
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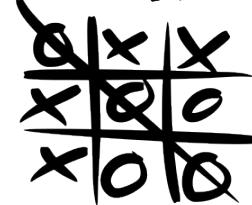
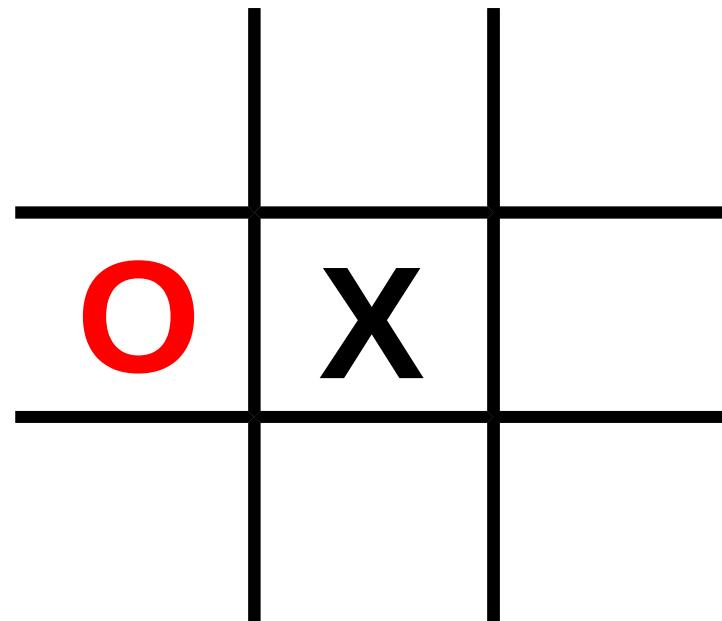
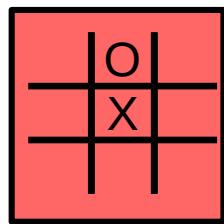
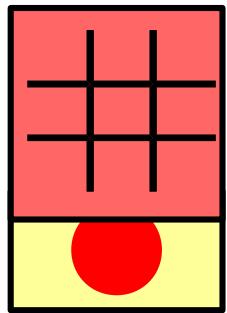
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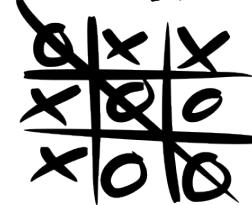
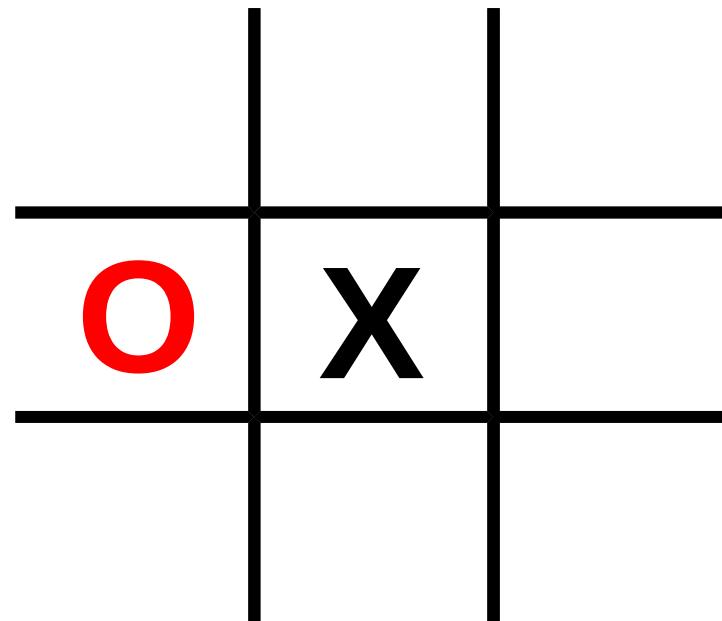
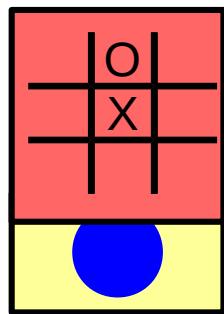
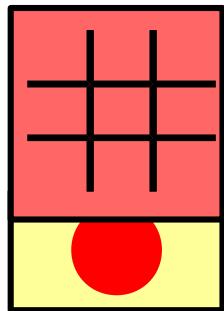
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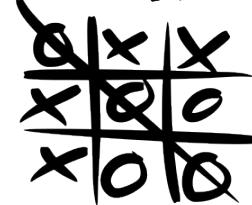
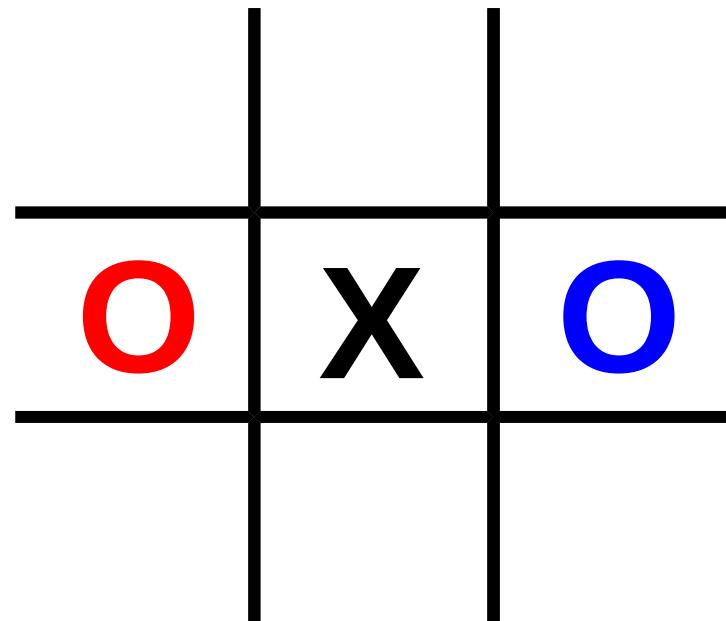
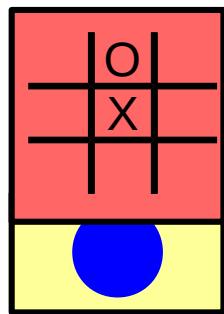
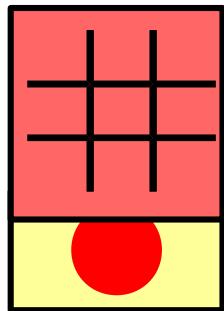
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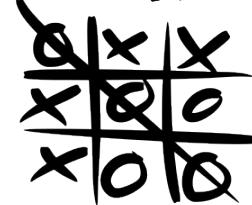
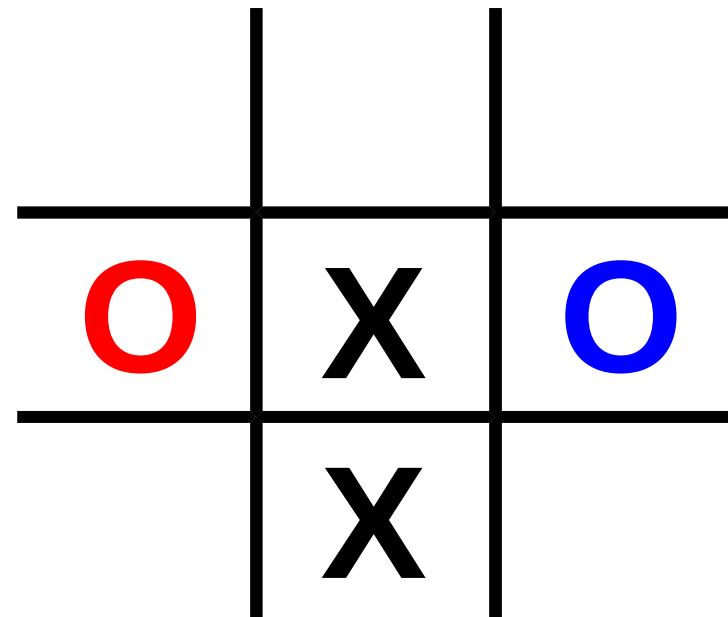
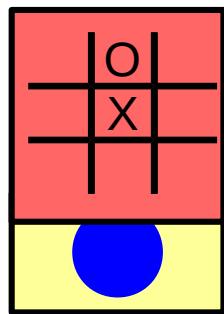
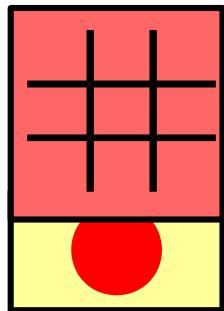
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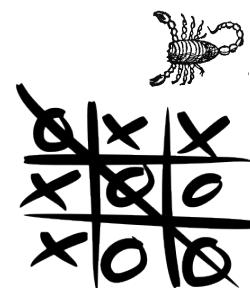
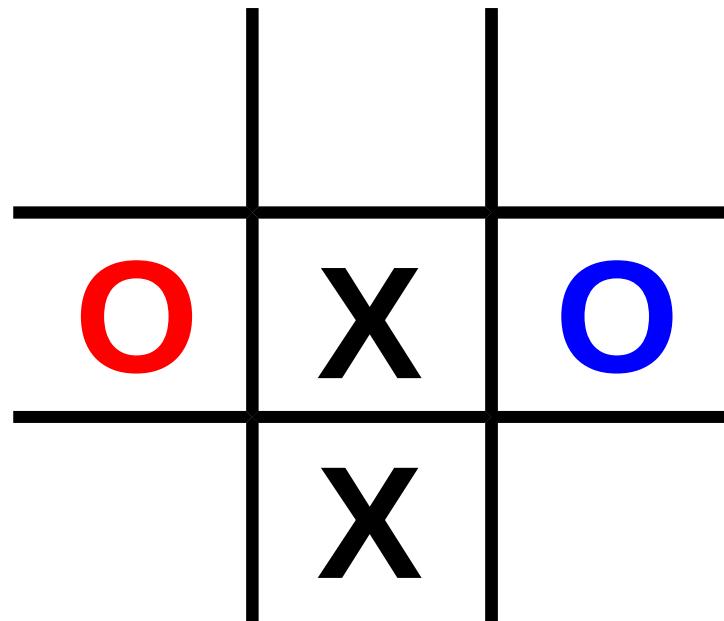
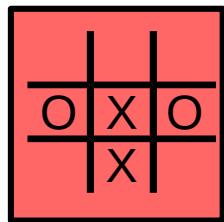
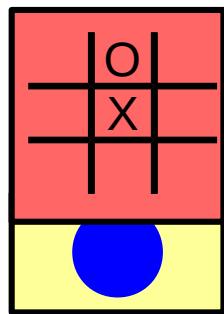
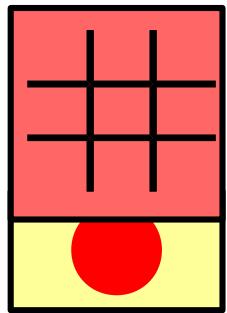
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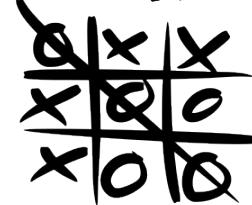
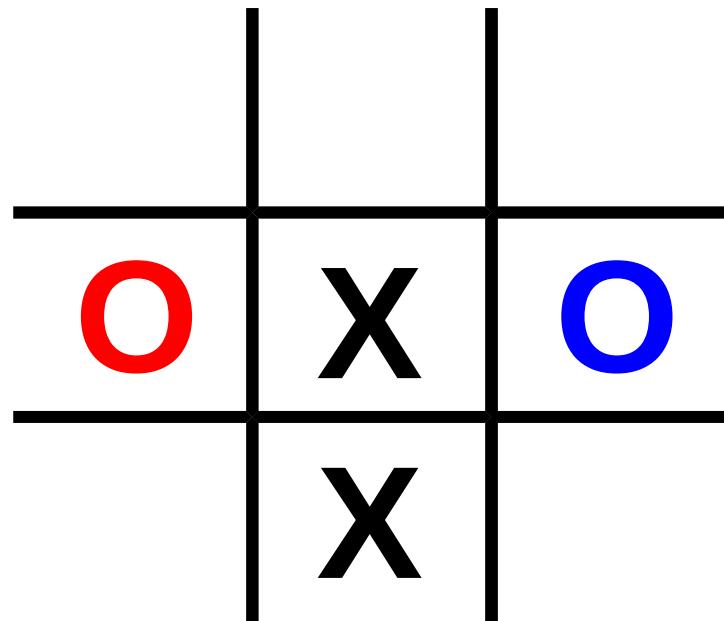
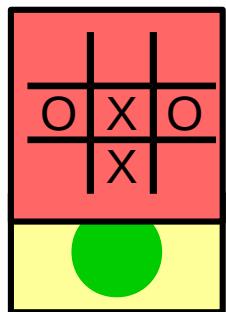
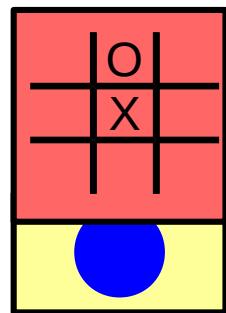
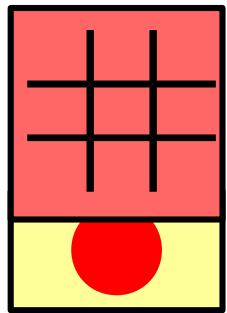
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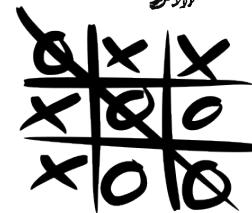
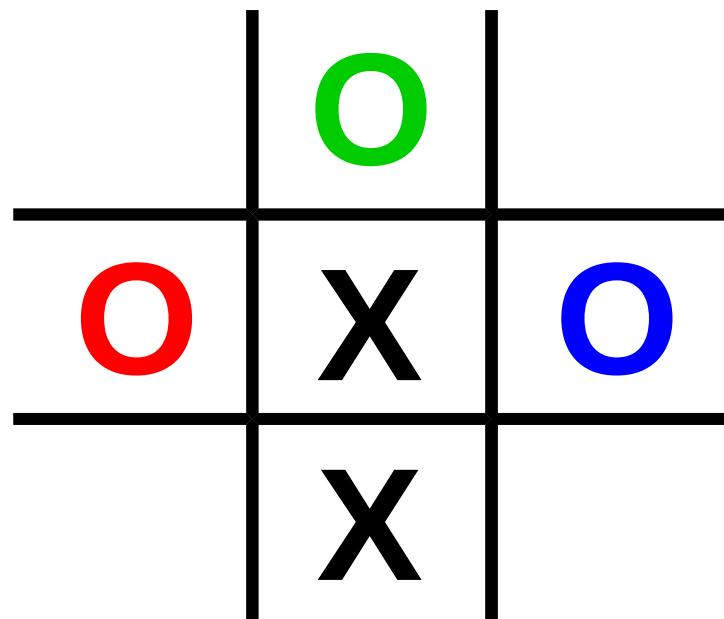
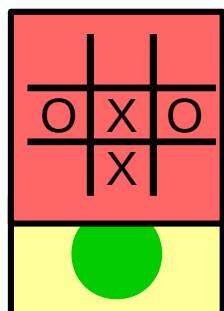
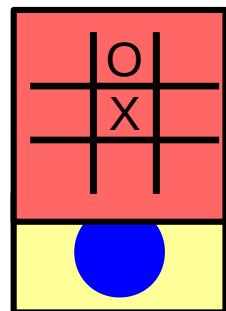
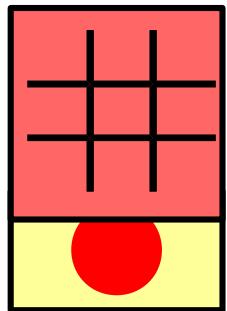
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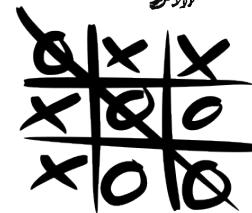
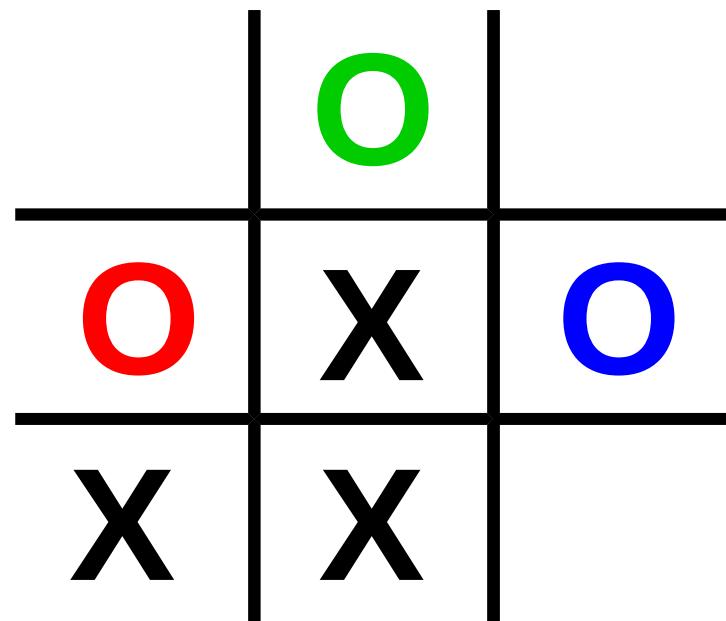
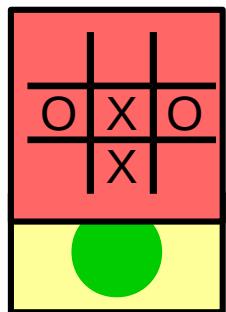
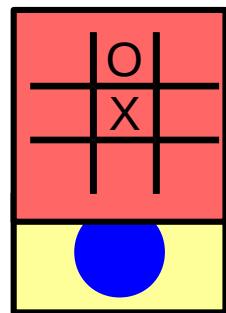
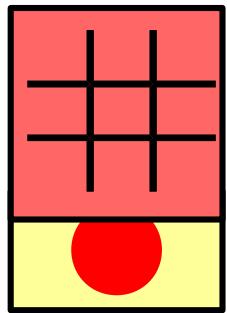
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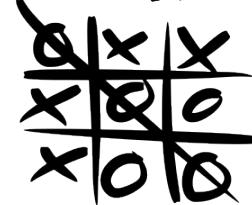
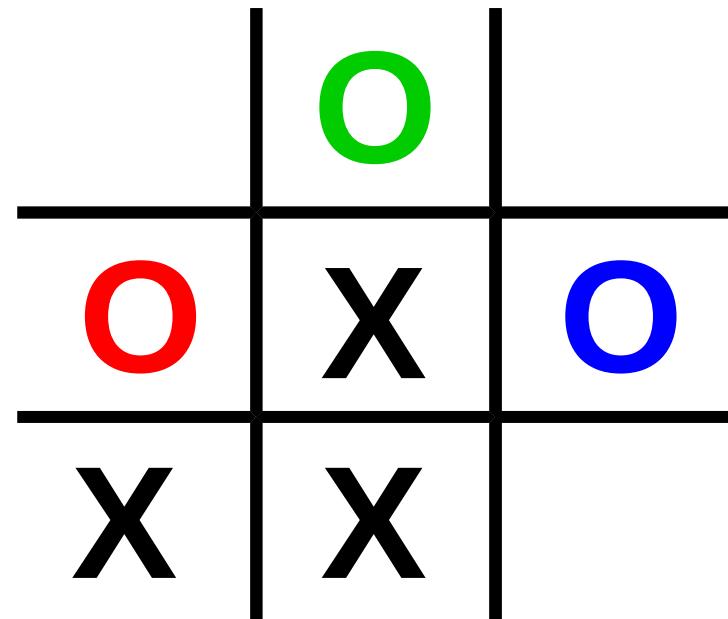
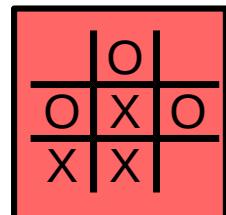
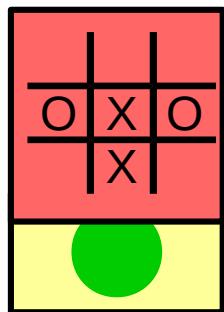
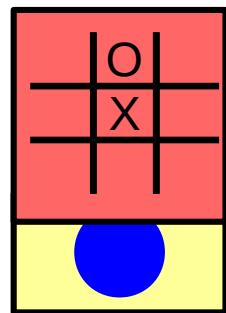
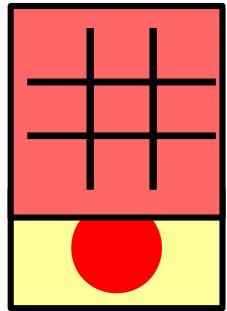
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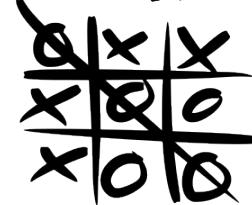
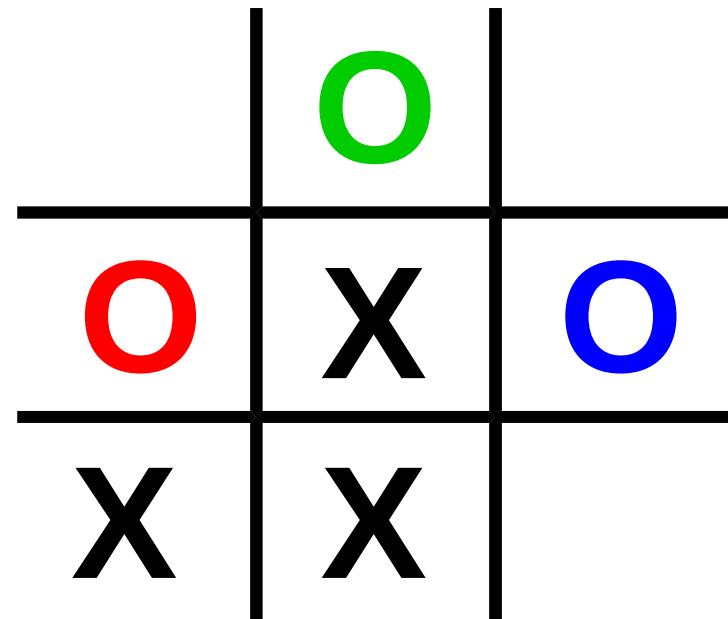
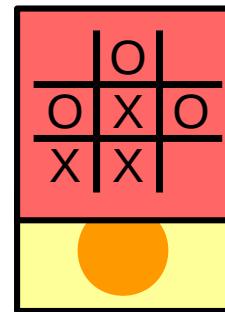
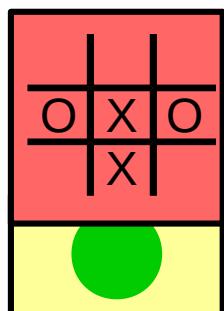
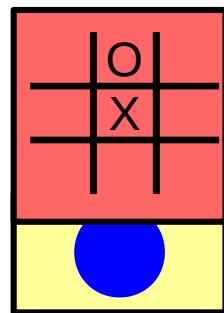
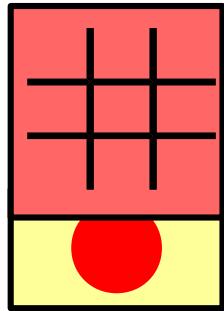
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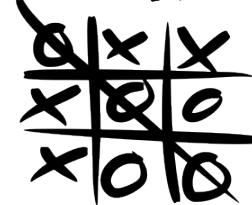
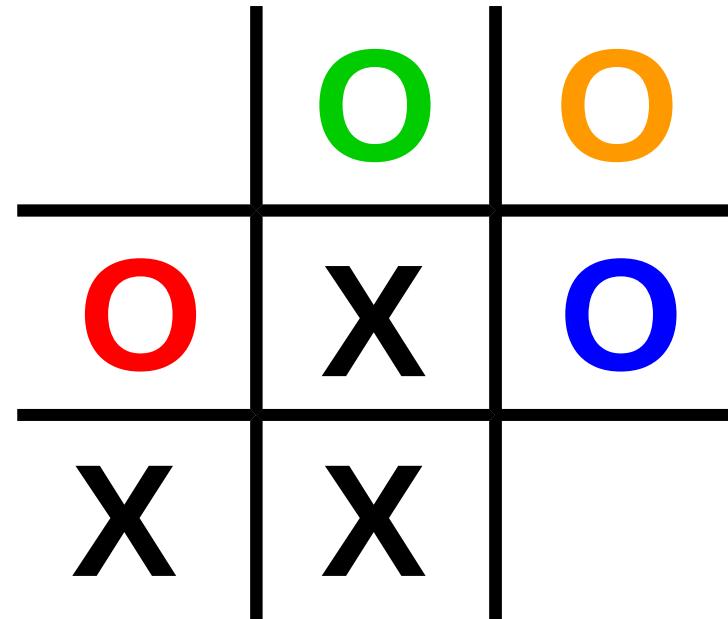
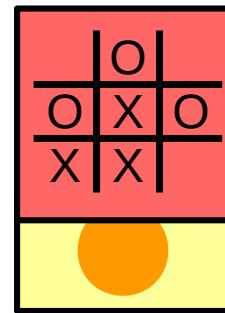
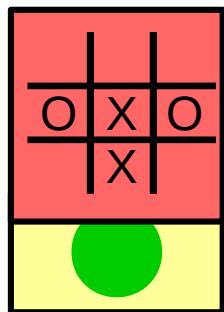
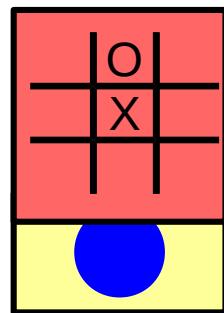
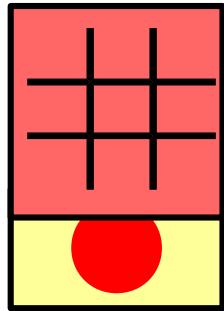
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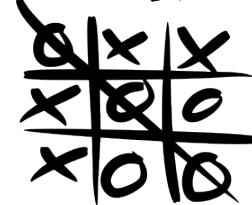
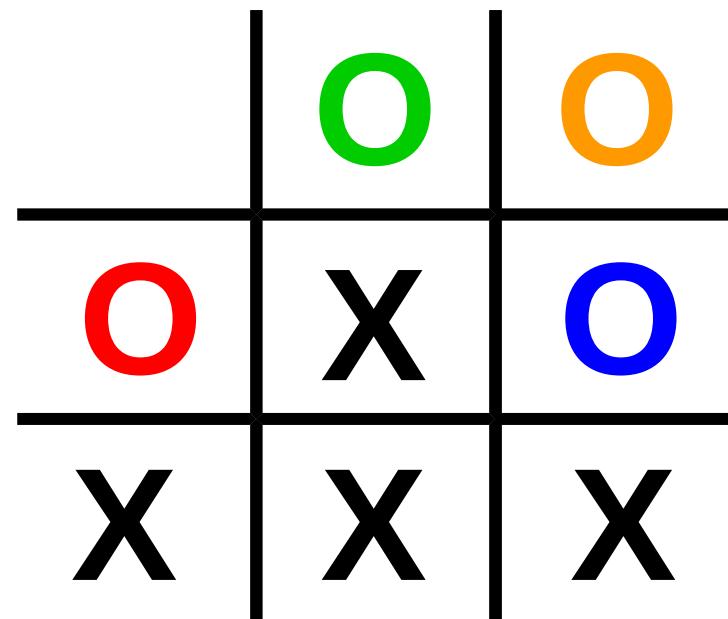
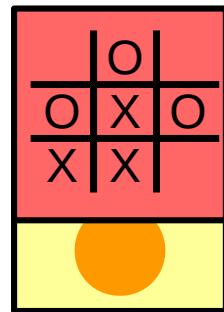
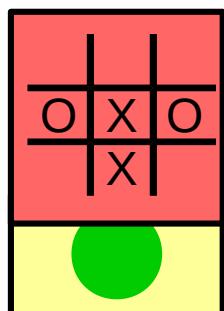
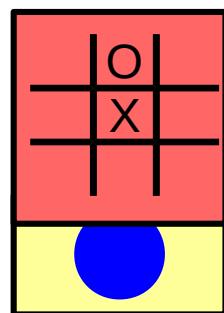
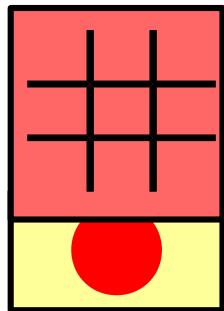
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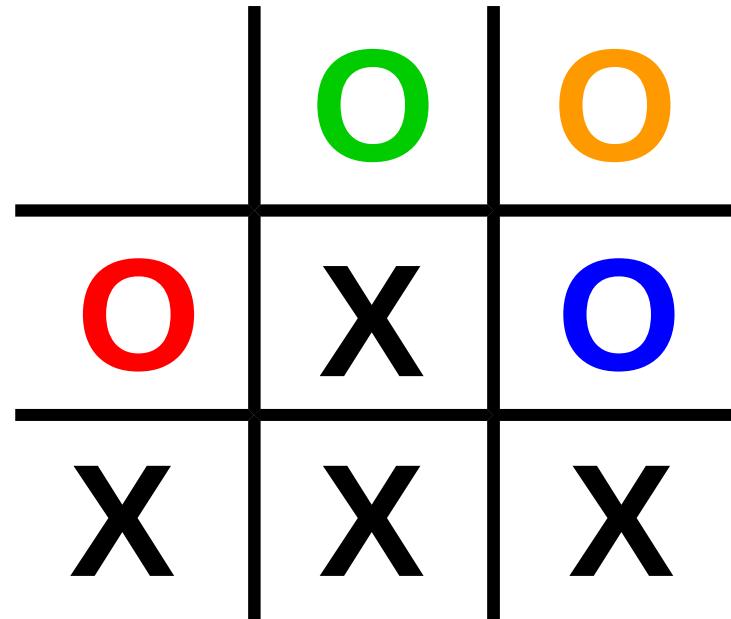
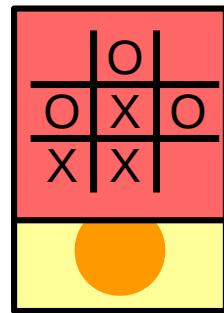
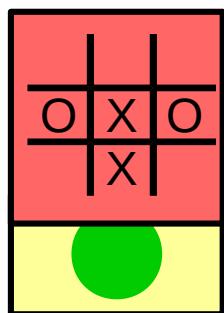
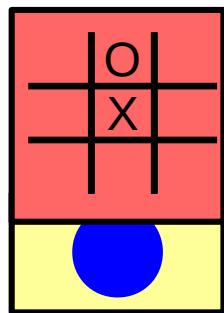
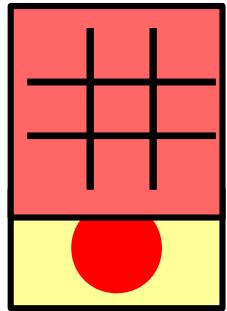
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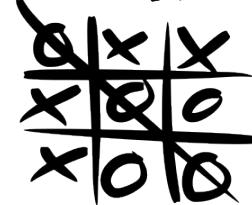
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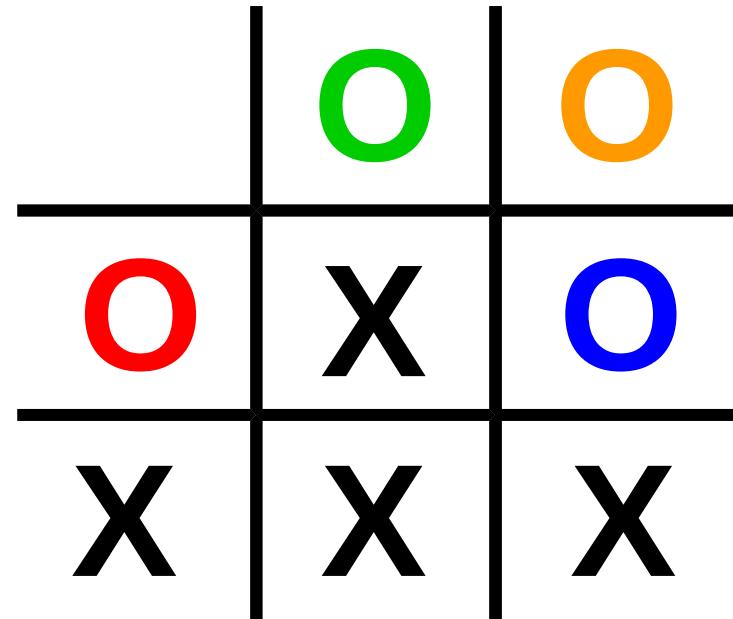
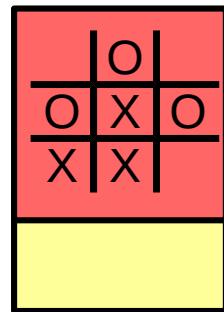
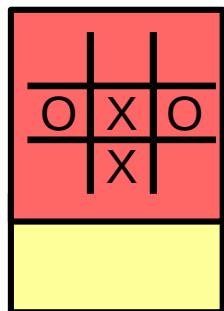
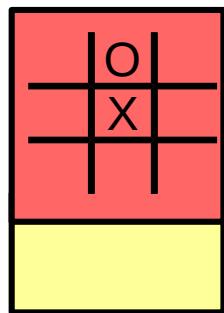
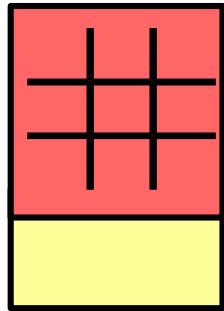
# MENACE



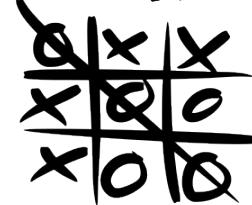
Lose → -1 bead



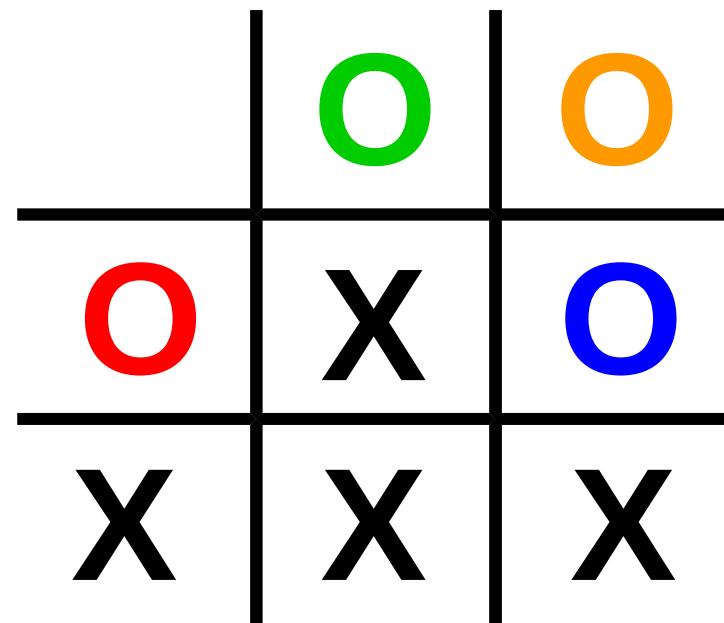
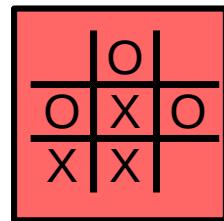
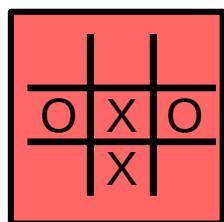
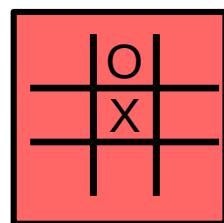
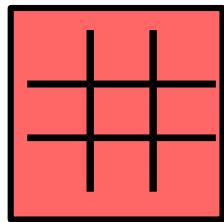
# MENACE



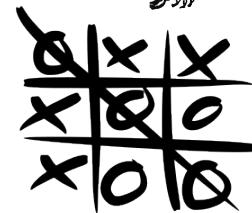
Lose → -1 bead



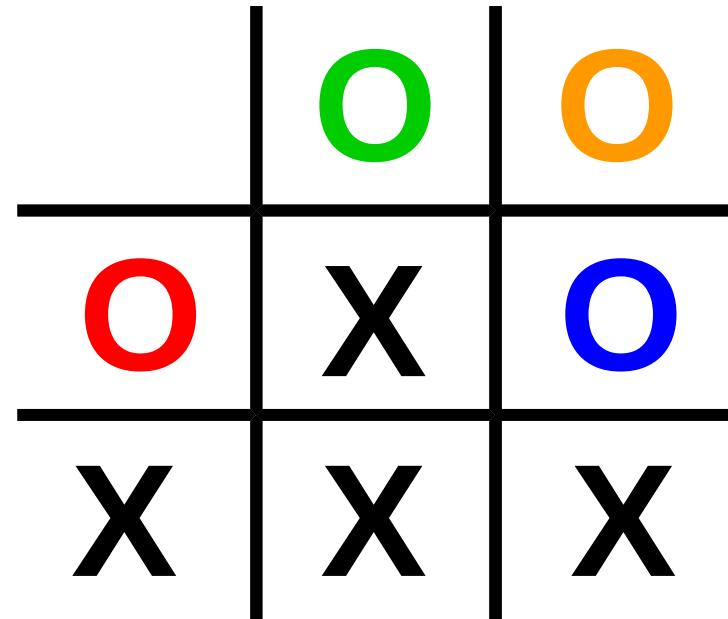
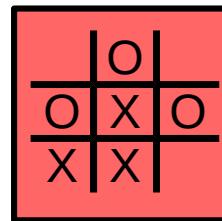
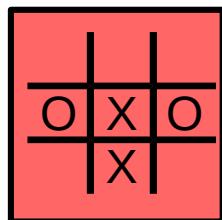
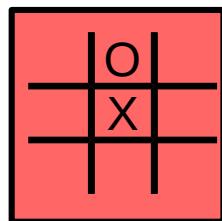
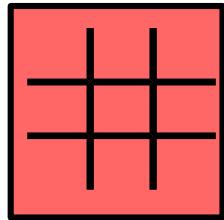
# MENACE



Lose → -1 bead

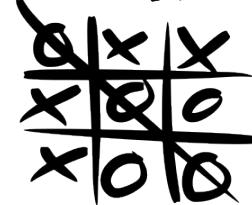


# MENACE

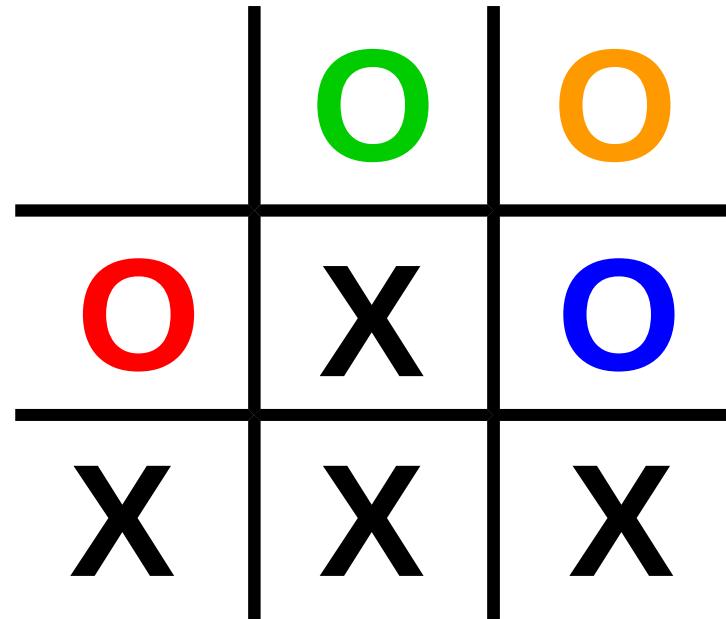
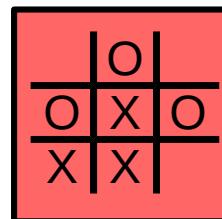
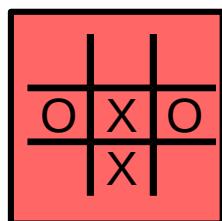
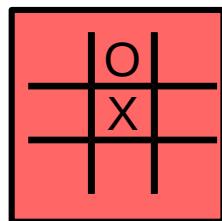
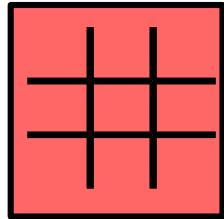


Lose → -1 bead

Win → +3 beads



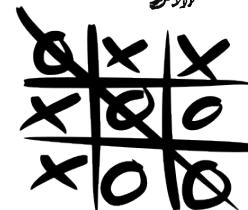
# MENACE



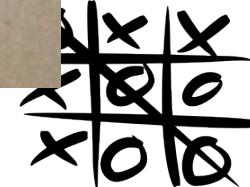
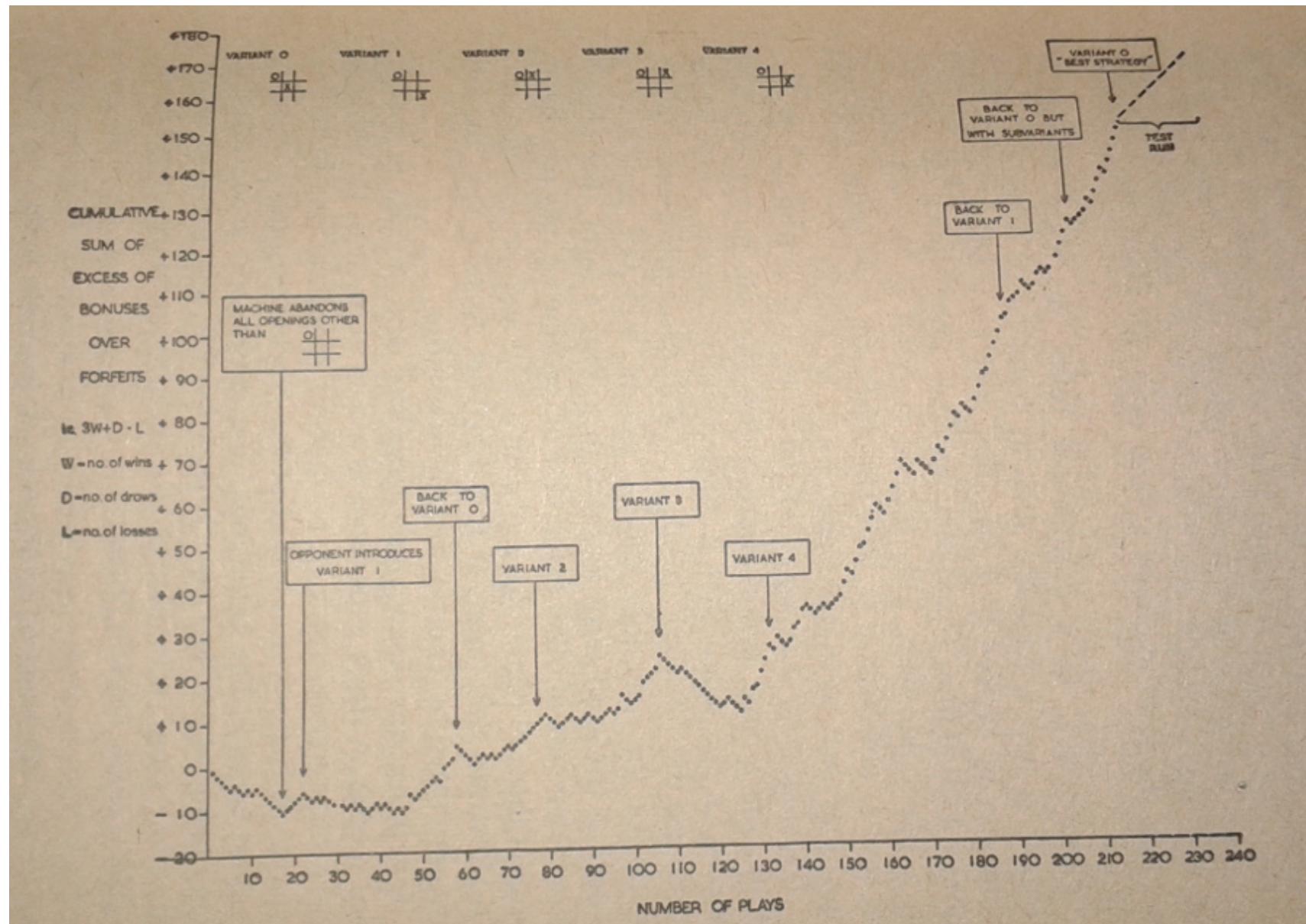
Lose → -1 bead

Win → +3 beads

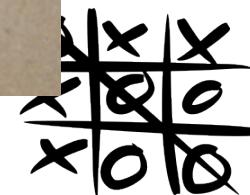
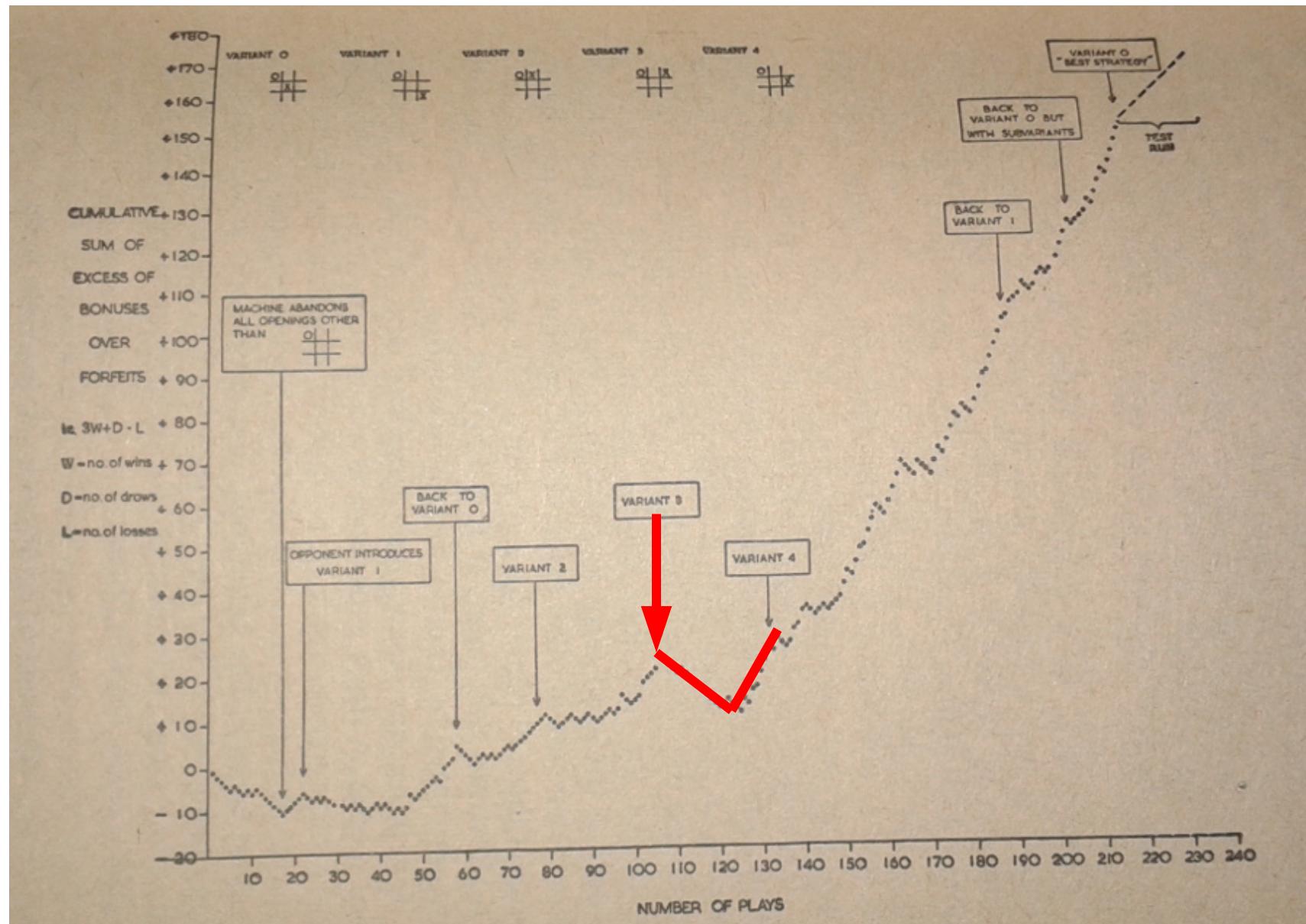
Draw → +1 bead



# MENACE



# MENACE



# Connect 4



# Connect 4

- 4 531 985 219 092 possible positions



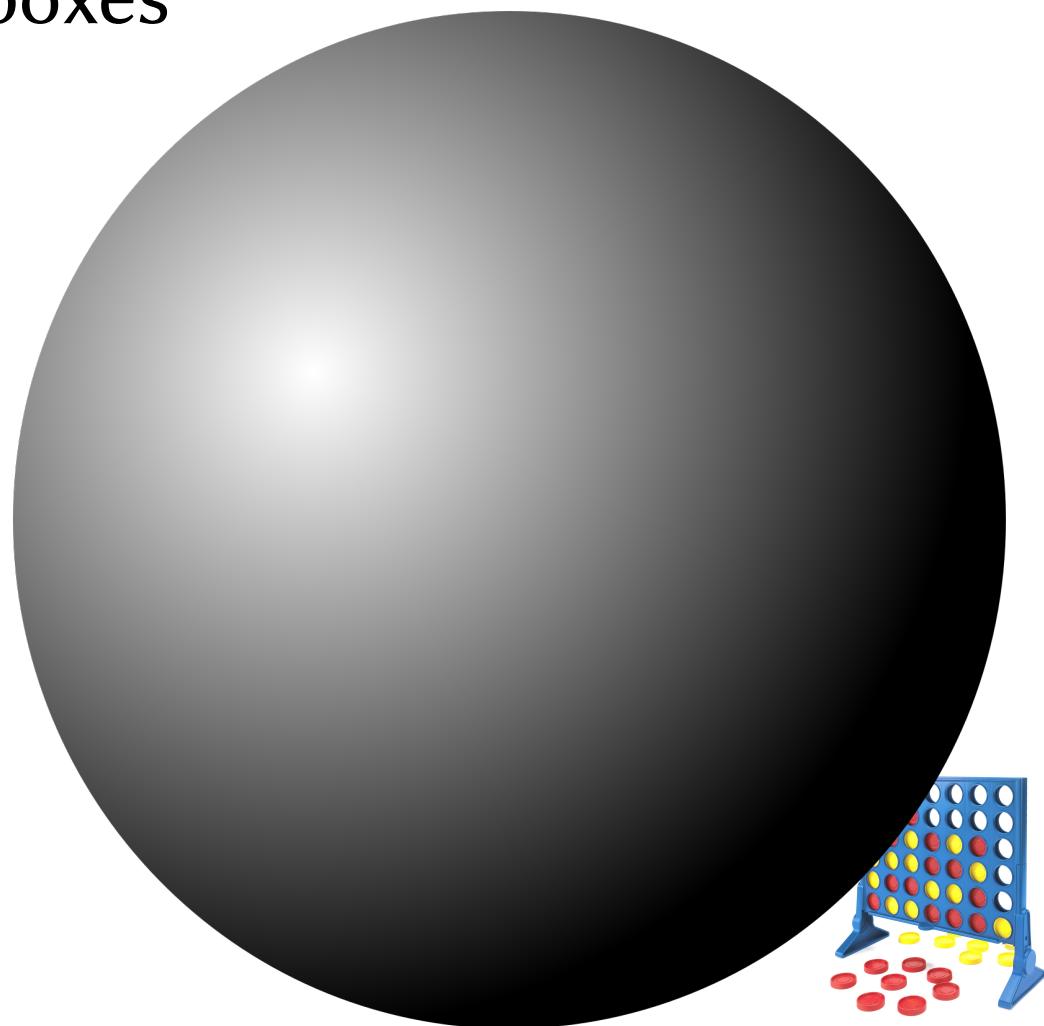
# Connect 4

- 4 531 985 219 092 possible positions
- 104 371 619m<sup>3</sup> of matchboxes



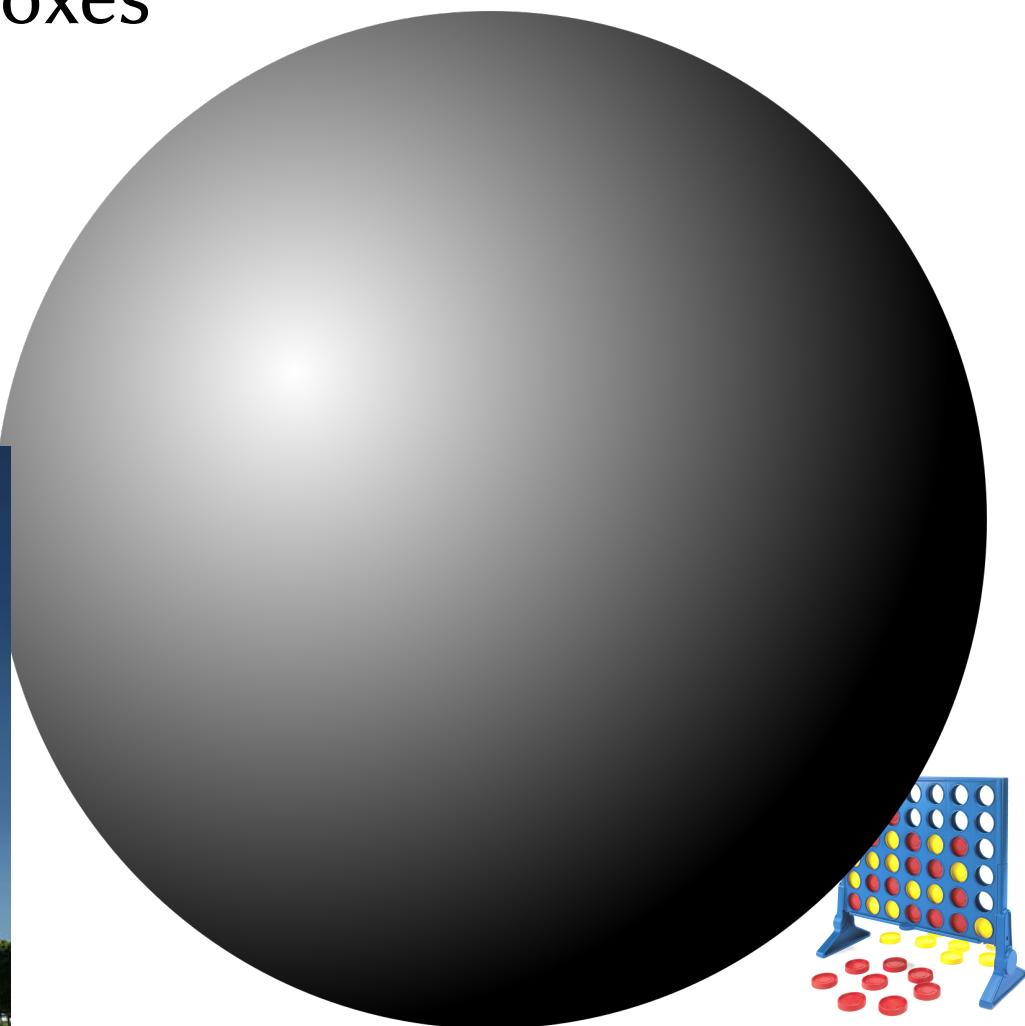
# Connect 4

- 4 531 985 219 092 possible positions
- 104 371 619m<sup>3</sup> of matchboxes



# Connect 4

- 4 531 985 219 092 possible positions
- 104 371 619m<sup>3</sup> of matchboxes



# Chess



# Chess

- Around  $10^{43}$  possible positions



# Chess

- Around  $10^{43}$  possible positions
- Around  $10^{38}m^3$  of matchboxes



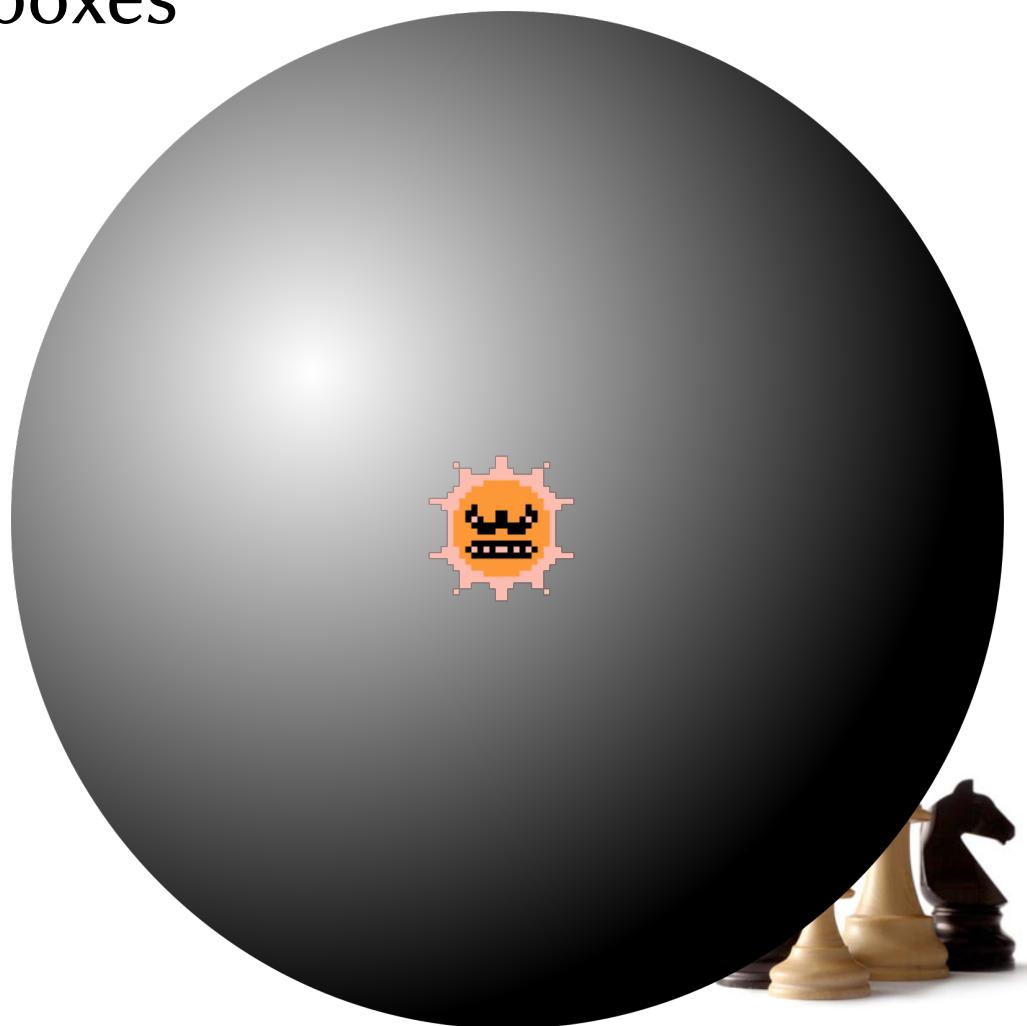
# Chess

- Around  $10^{43}$  possible positions
- Around  $10^{38}m^3$  of matchboxes



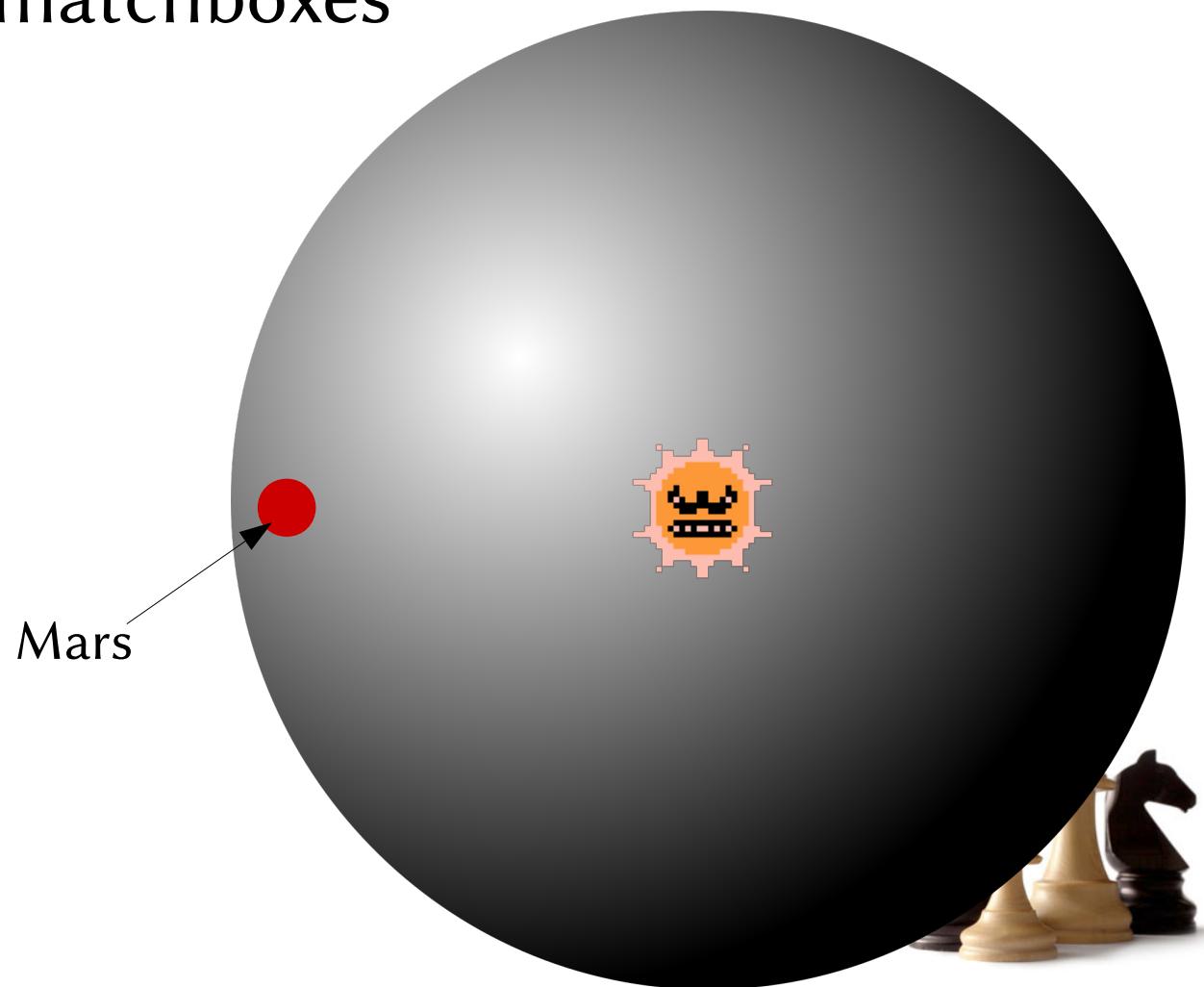
# Chess

- Around  $10^{43}$  possible positions
- Around  $10^{38}m^3$  of matchboxes

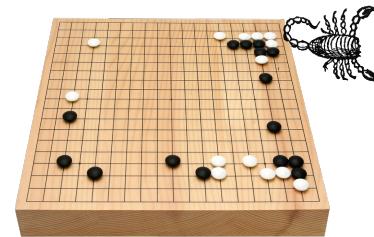


# Chess

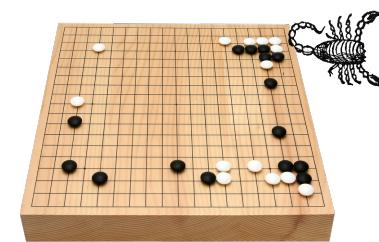
- Around  $10^{43}$  possible positions
- Around  $10^{38} \text{m}^3$  of matchboxes



# Go (19 by 19)

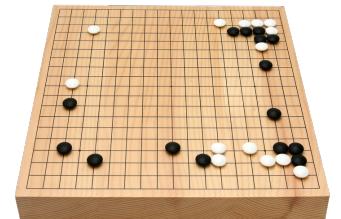


# Go (19 by 19)



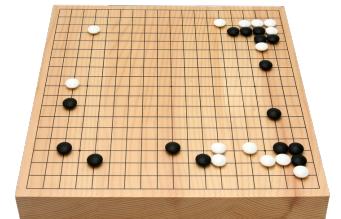
# Go (19 by 19)

- Estimated  $10^{170}$  possible positions



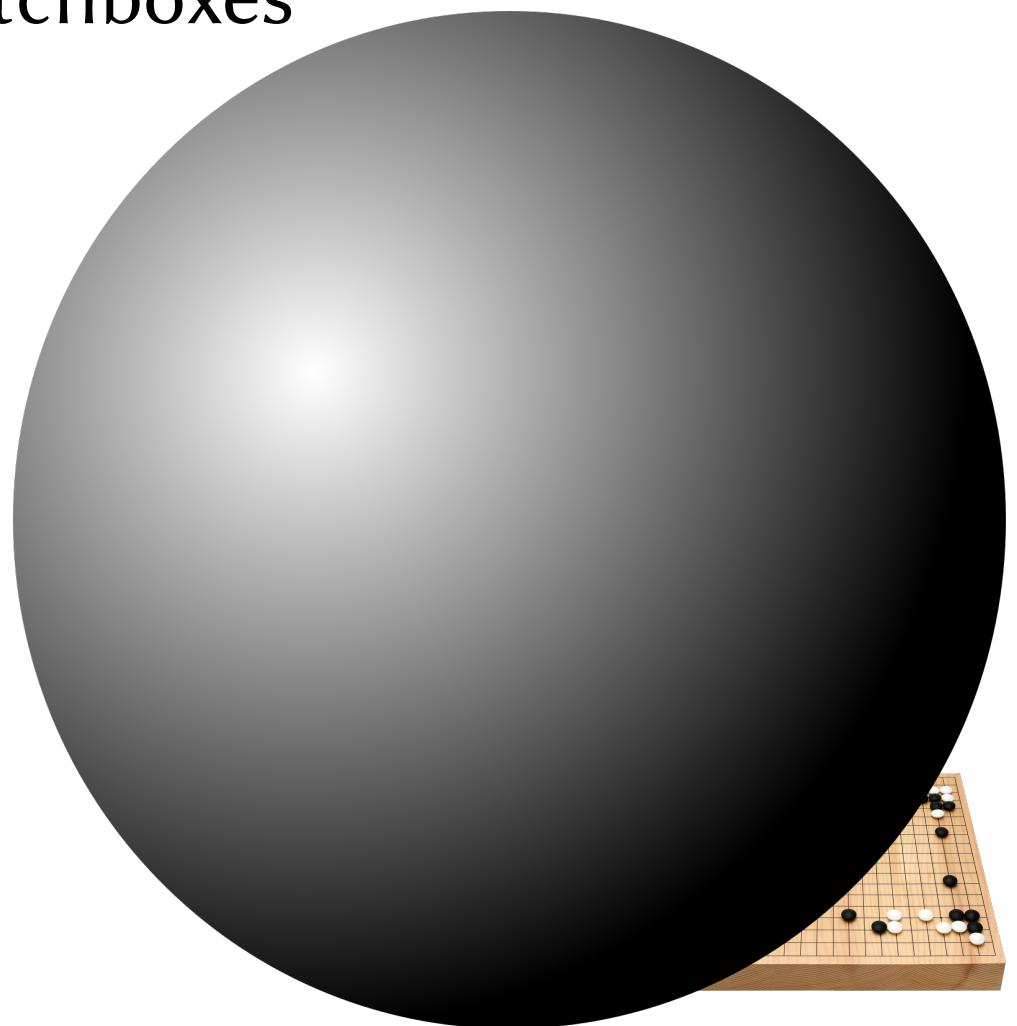
# Go (19 by 19)

- Estimated  $10^{170}$  possible positions
- Estimated  $10^{165} \text{m}^3$  of matchboxes



# Go (19 by 19)

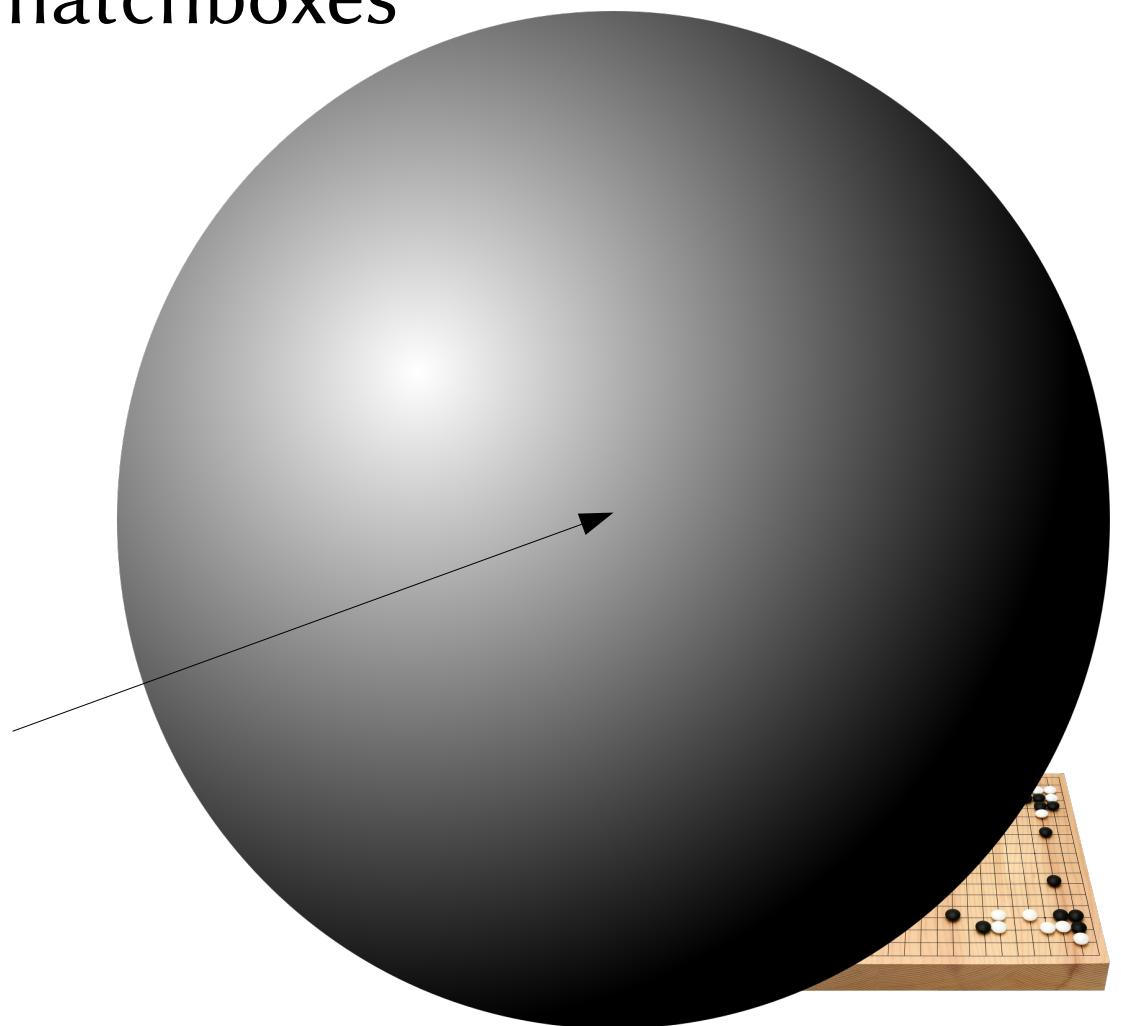
- Estimated  $10^{170}$  possible positions
- Estimated  $10^{165} \text{m}^3$  of matchboxes



# Go (19 by 19)

- Estimated  $10^{170}$  possible positions
- Estimated  $10^{165} \text{m}^3$  of matchboxes

The observable universe

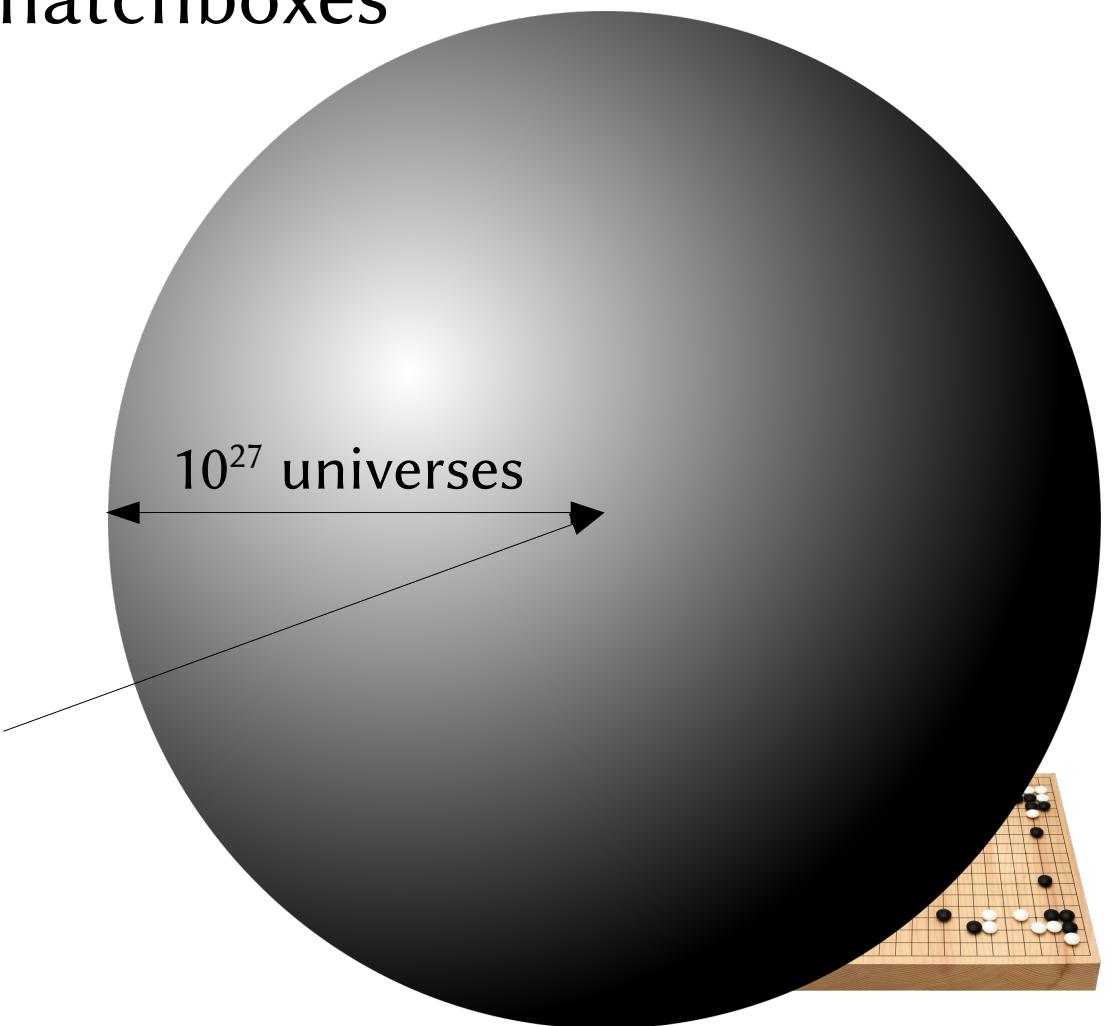


# Go (19 by 19)

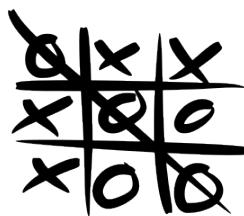
- Estimated  $10^{170}$  possible positions
- Estimated  $10^{165} \text{m}^3$  of matchboxes

The observable universe

$10^{27}$  universes



[mscroggs.co.uk/menace](https://mscroggs.co.uk/menace)



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## MENACE

This page contains MENACE: a Machine Educable Noughts And Crosses Engine. MENACE was first built by Donald Michie in 1960 using 304 matchboxes. You can read about how MENACE works [here](#).

You can play against MENACE below. As you play against it, it will learn to be a better player.

You can find the source code for this implementation on [GitHub](#).

O: MENACE  
X: Human

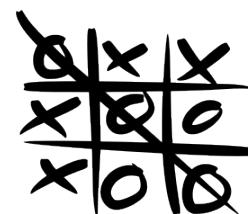
MENACE Wins 1      Draws 0      Human Wins 4

MENACE wins.  
You win.  
You win.  
You win.  
You win.

These are the 304 matchboxes which power MENACE.

Adjust MENACE's settings

0 0 0	o x 4	o 0 0	o 4 4	x o 4	0 o 4	x 4 o	4 x 4
0 5 0	4 4 4	4 x 0	4 4 x	7 4 4	0 x 3	4 4 4	o 4 4
0 10 8	4 4 4	4 4 4	4 4 4	4 4 4	0 4 4	4 4 4	4 4 4
x 0 0	0 x 4	x 4 4	0 x 4	x 0 0	o 0 2	o 0 2	o 0 2
4 o 0	0 o 4	4 4 o	0 4 4	4 4 0	2 x x	2 x 2	2 2 x
2 4 3	0 4 4	4 4 4	0 o 4	4 4 o	2 2 2	2 x 2	2 x 2
o x o	o x o	o x o	o 2 o	x o o	x o o	x o o	x o o
x 2 2	0 x 2	0 2 2	0 x 2	2 x 2	2 2 x	2 2 2	2 2 2
2 2 2	0 2 2	0 x 2	0 x 2	2 2 2	2 2 2	x 2 2	2 x 2
x o o	o x 2	o x 2	o x 2	x o x	x o 0	x o 2	x o 0
2 2 2	o x 2	o 2 x	o 2 2	o 2 2	o x 0	o 2 x	o 2 0
2 2 x	2 2 2	2 2 2	2 x 2	2 2 2	2 2 5	2 2 2	2 2 x
x x o	o x 0	o x 2	o x 2	o 0 0	x o x	x o 2	x o 2
o 2 2	x o 0	2 o x	2 o 2	2 o x	0 o 2	2 o x	2 o 2
2 2 2	2 2 2	2 2 2	2 x 2	2 x 2	0 2 2	2 2 2	x 2 2
x o 2	x o 2	x x o	x 2 o	x 2 o	x 0 o	x x 2	0 x 0
2 o 2	2 o 2	2 o 2	2 o x	2 o x	0 o 2	o o 2	o o 2
2 x 2	2 2 x	2 2 2	2 x 2	2 2 2	2 x 2	2 2 2	2 x 2
o x 2	o x 2	o x 2	x o 1	x o 2	x o 2	x o 2	x x o
x 2 o	x 2 o	2 2 o	2 x o	2 2 o	2 2 o	0 2 o	2 2 o
2 2 2	2 2 2	2 x 2	2 2 2	x 2 2	2 x 2	2 2 x	2 2 2
x 2 o	x 2 o	x x 2	0 x 2	0 x 0	x x 2	2 x 2	o x 2
2 x o	2 2 o	o 2 o	o x o	o 2 o	2 o o	x o o	2 x 2
2 2 2	2 x 2	2 2 2	0 2 2	0 x 2	2 2 2	2 2 2	o 2 2
o x 2	o x 0	x o x	x o 2	x o 2	x o 2	x o 2	x x o
2 2 x	2 2 2	2 2 2	2 x 2	2 2 x	2 2 2	2 2 2	2 2 2
o 2 2	o x 2	o 2 2	o 2 2	o 2 2	o x 2	o 2 x	o 2 2
x 0 o	x 2 o	x 0 o	x x 2	x x 2	x 2 x	x x 2	o x 2
2 x 0	2 2 x	0 2 0	o 2 2	2 o 2	1 o 1	2 2 o	2 x 2





# Thank-you for listening!

Matthew Scroggs



@mscroggs

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