# Games Circus

## 1. 15 boxes

Players take it in turns to place a counter in an empty box.

The first player to get three consecutive boxes with counters in is the winner.

Here is how one game went (It was a win for A on her fourth move):

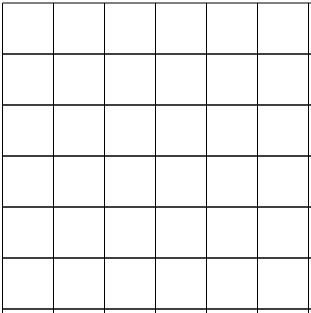
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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| O | O | O |  |  | O |  |  | O |  |  | O |  |  | O |
| B3 | A4 | A2 |  |  | A1 |  |  | B1 |  |  | B2 |  |  | A3 |

1. Which player should win - the one that goes first, or the one that goes second? Can you find a winning strategy?
2. What is the strategy if the first to get three consecutive boxes *loses*?

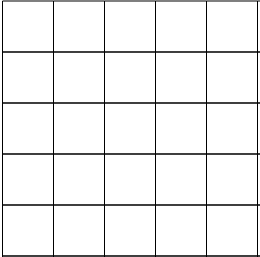
Reference: Averbach p 250.

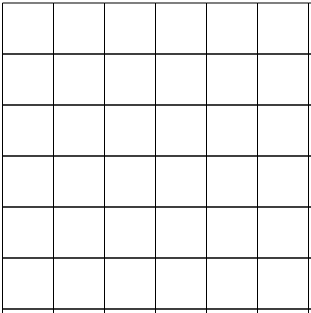
## 2. Cram

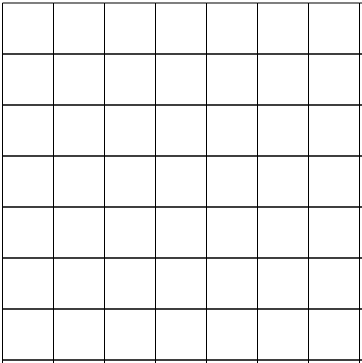
Players take it in turns to place a domino on a 6 x 6 square grid.   
It is assumed that the domino covers two adjacent squares on the grid.   
The player that cannot move loses.

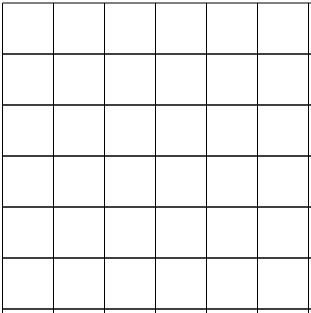


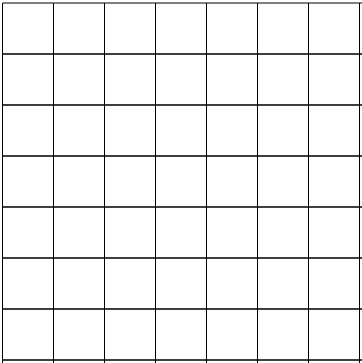
1. Which player should win - the one that goes first, or the one that goes second? Can you find a winning strategy?
2. What about a 7x7 grid? …
3. What is the strategy if the first person that cannot move *wins*?
4. What happens when you use triominoes?



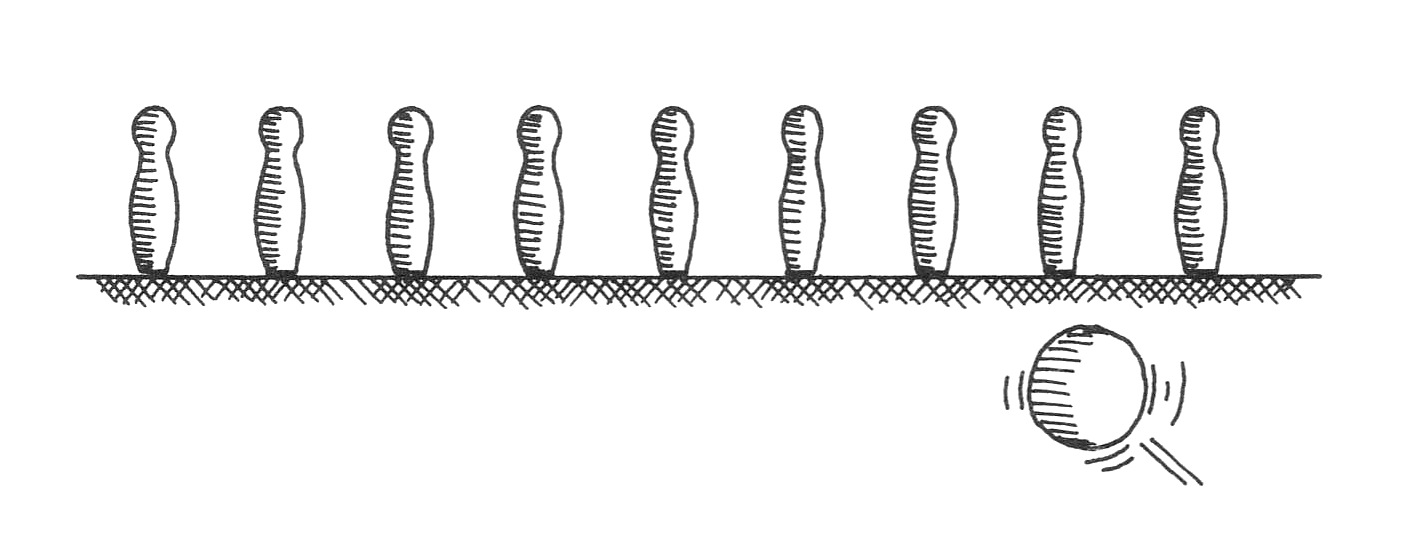








## 3. Kayles



This is an old 14th Century game for two players.   
The ball can knock down either a single pin or two adjacent pins standing next to each other.

Players alternately roll a ball and the player that knocks over the last pin (or pair of pins) wins.

Assuming that you are not allowed to miss (you just roll again).

What is the first player’s winning strategy?

Try different numbers of pins.

Suppose there is a pin missing at the start ...













## 4. Lewthwaites Game

Place the counters as shown on the board below.

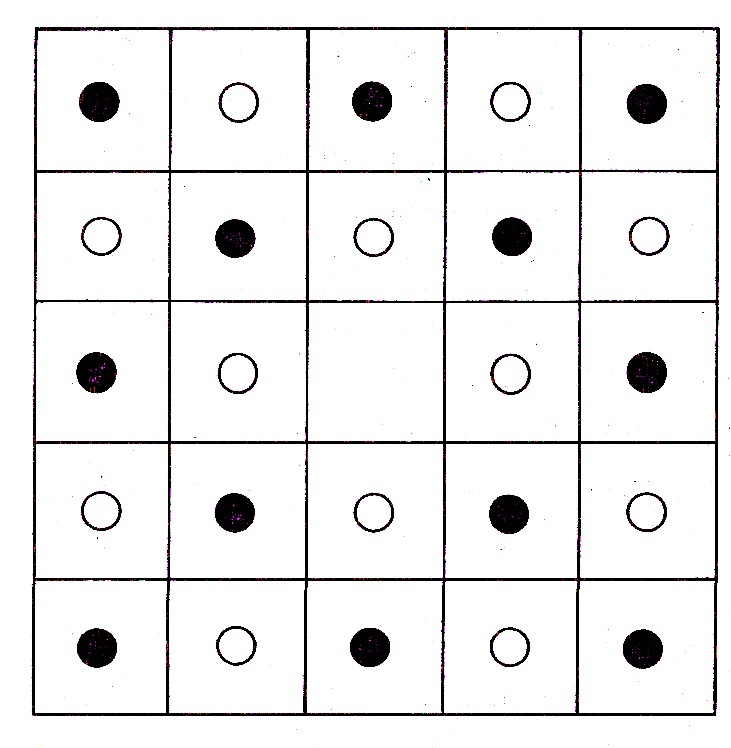
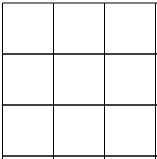
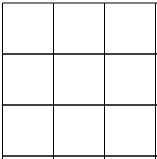
Take turns at moving the counters orthogonally to the vacant square.

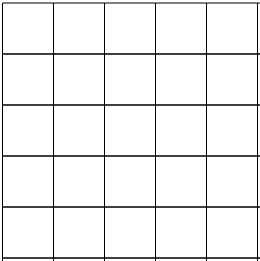
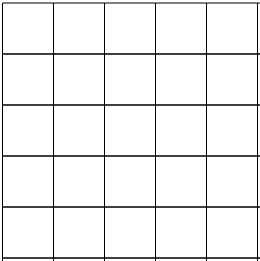
The first player that is unable to move loses.

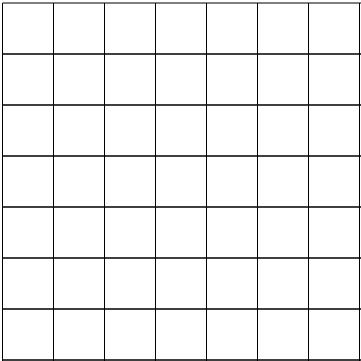
Prove that the game has to end after at most 12 moves.

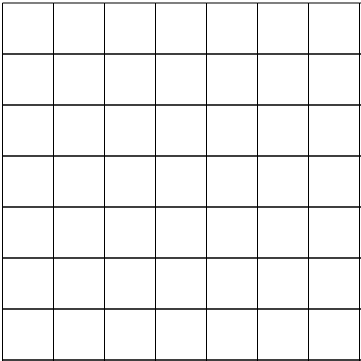
Prove that the second play can always win.

(Try different size boards.)

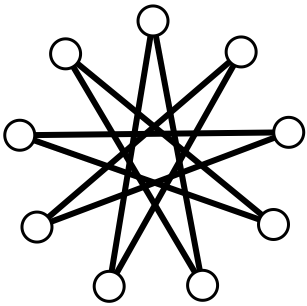
 





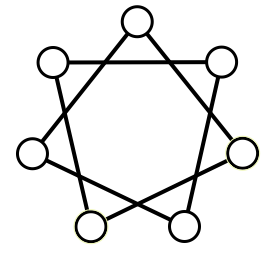
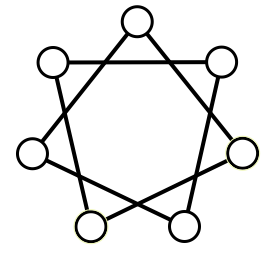
## 5. Star

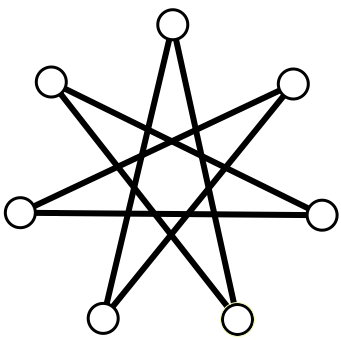
Put a counter on each of the star’s nine points.

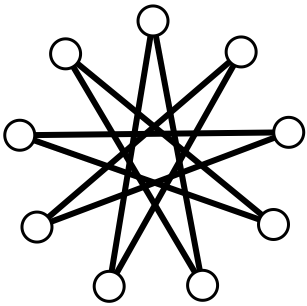


Players A and B take turns at removing either one counter or two counters joined by a line. The player who takes the last counter wins.

Prove that player B can always win.







## 6. 3D Noughts and Crosses



Players take turns at placing marbles. The first to get three in a row wins.

Rows may be any direction, horizontal, vertical, diagonal.

How can Player A ensure that she does not lose?