

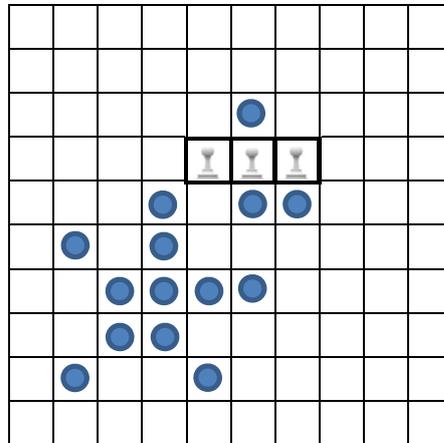
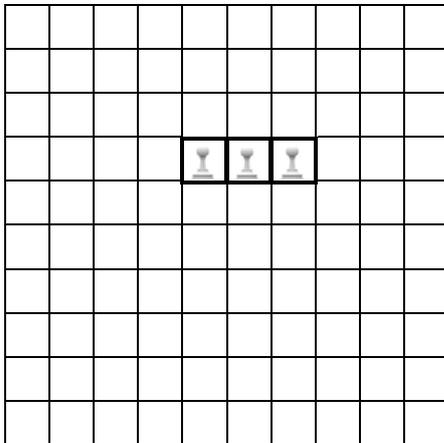
"Retrolife - revisited" – an exchange gift for the 10'th Gathering for Gardner

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Retrolife is the name of a puzzle we introduced at G4G7 [1]. The aim of the puzzle is to find predecessors (assuming certain constraints) for the Game of Life, a one-player cellular automata game invented by John Conway [2] and popularized by Martin Gardner [3]. Since then, a few Retrolife challenges have been published [4] [5] [6].

Retrolife puzzles can be redefined as a class of puzzles and generalized in the following manner [5]. A player is given an infinite chessboard, some pawns with which he creates a pattern on the board, and some tokens. Every square on the board has eight surrounding (or neighboring) cells in the directions north, south, west, and east and on the diagonals.  $p$ ,  $t$  and  $e$  are whole numbers between 1 and 8. The challenge is to surround each pawn with  $p$  tokens, making sure that no token has  $t$  neighbors and no empty squares on the board are surrounded by  $e$  tokens. A formidable challenge is to find the *minimum* number of tokens that can be used.

Here is an example of a generalized Retrolife puzzle and a possible (not necessarily minimum) solution, given  $p = 3$ ,  $t = 2$  and  $e = 2$ . In other words, surround each pawn on the board with 3 tokens so that no token has 2 neighbors and no empty square is surrounded by 2 tokens.



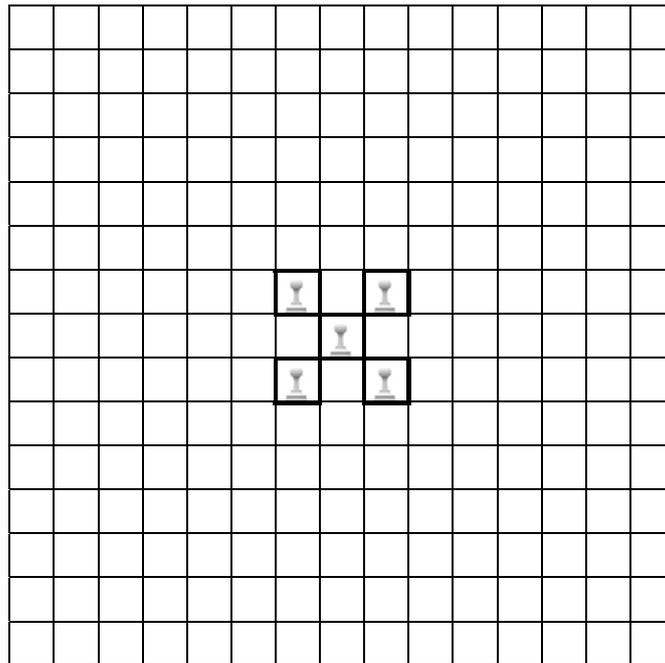
The original Retrolife problem corresponding to the inverse Game of Life [4] is retrieved when  $p = 3$ ,  $t = 2,3$  and  $e = 3$ . Note that  $t$  is in this case a vector, meaning that a token may not have two *or* three neighboring tokens – but it may have more or less.

In the spirit of the X'th Gathering for Gardner we challenge the reader with the following three generalized Retrolife puzzles. Surround the X of pawns with tokens so that each pawn is surrounded by  $p$  tokens, no token has  $t$  neighbors and no empty square is surrounded by  $e$  tokens, where  $p$ ,  $t$  and  $e$  are:

- a)  $p=2, t=2, e=2$
- b)  $p=4, t=2, e=2$
- c)  $p=3, t=2,3, e=3$

Use the minimum number of tokens possible.

Solutions may be sent to (or obtained) via email: [yossi.elran@weizmann.ac.il](mailto:yossi.elran@weizmann.ac.il)



## Bibliography

- [1] Y. Elran, G4G7 Exchange Book, 2006.
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