

Retrolife Puzzles for Celebration of Mind 2017

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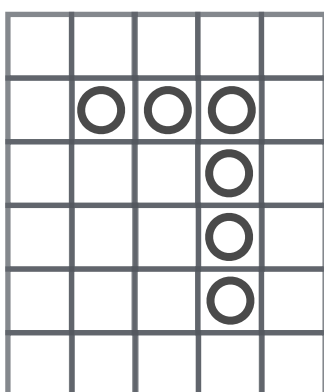
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Retrolife puzzles originated as design problems in John Conway's Game of Life. Since then, they have been rewritten as problems that can be played with black and white counters on an (in principal) infinite grid. Each square on the grid has 8 *surrounding* squares, 4 in each of the principal directions (North, South, West and East), and 4 on the diagonals. The white counters are used to set up the puzzle. They are placed on a rectangular grid, making a certain pattern. The object of the Retrolife puzzle is to place a minimal number of black counters on the grid so that they surround the white counters according to the following rules.

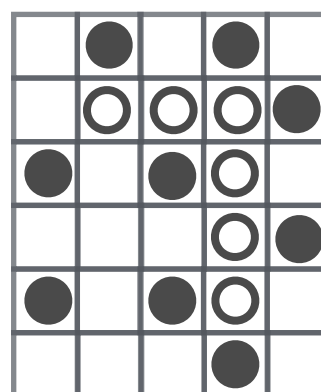
Surround each and every white counter with exactly 3 black counters in such a way that no black counter is surrounded by 2 other black counters or 3 other black counters (but they can be surrounded by 1 or more than 3), and no empty square on the board is surrounded by 3 black counters (again, more than 3 or less than 3 are allowed).

Here is a simple example of such a puzzle and its solution. Solutions can also be verified by plugging in the black counters into a 'Game of Life' simulation (see ref.) and advancing one step.

Puzzle



Solution

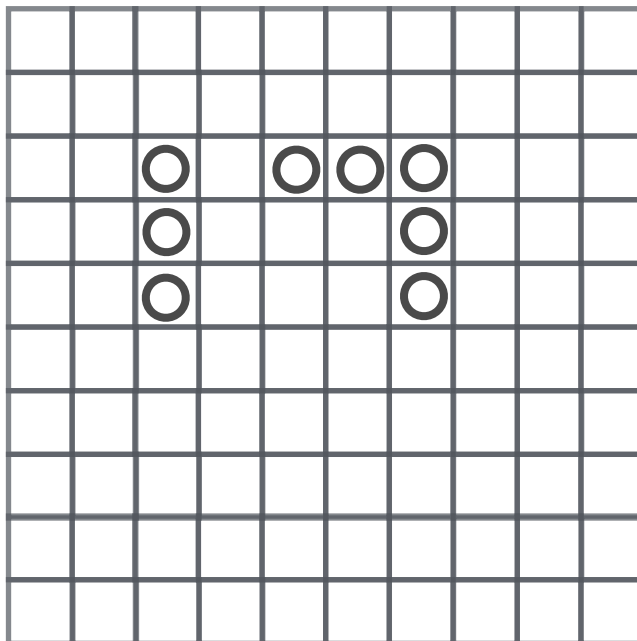


Puzzles

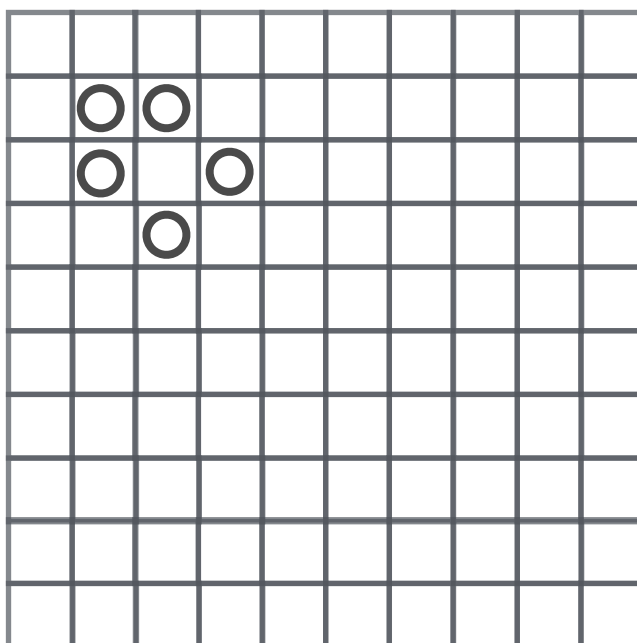
Following are two problems for Celebration of Mind 2017.

Seventeen:

There are six possible solutions using a minimal number of 9 black counters.

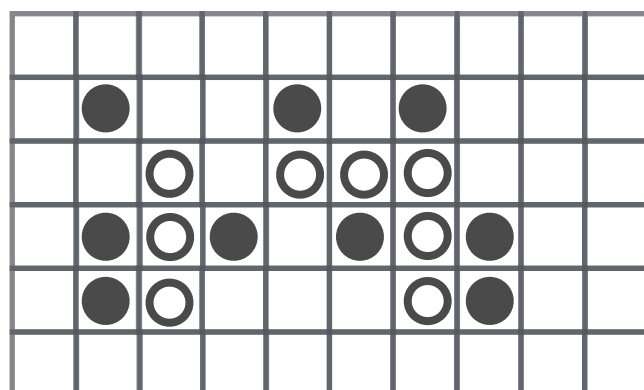
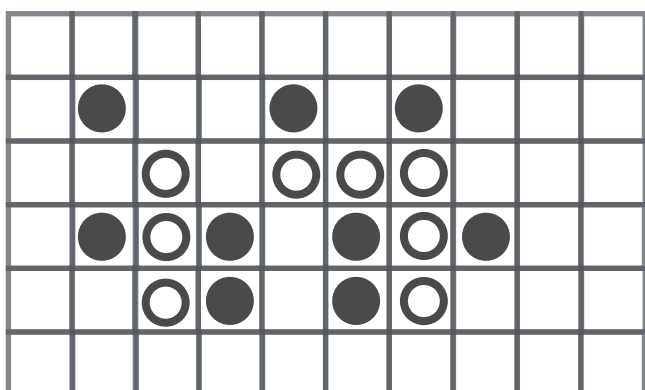
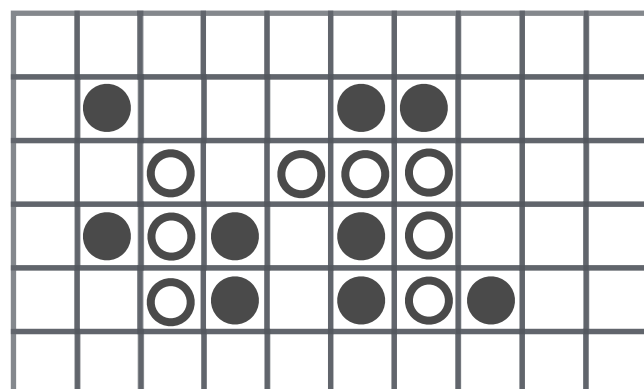
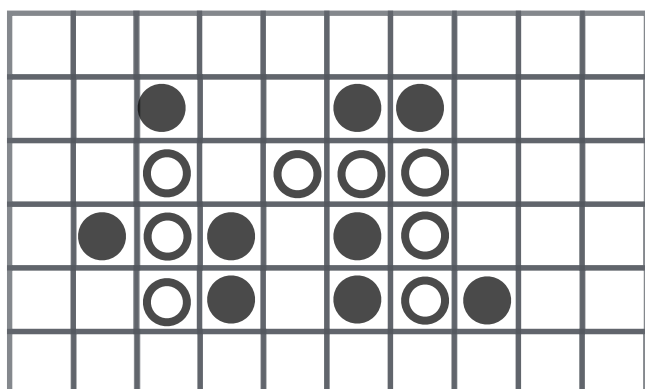
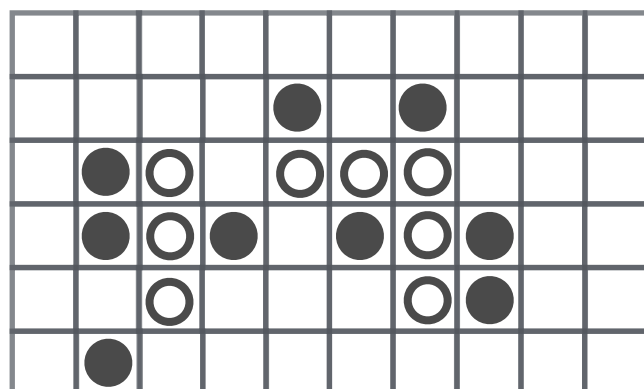
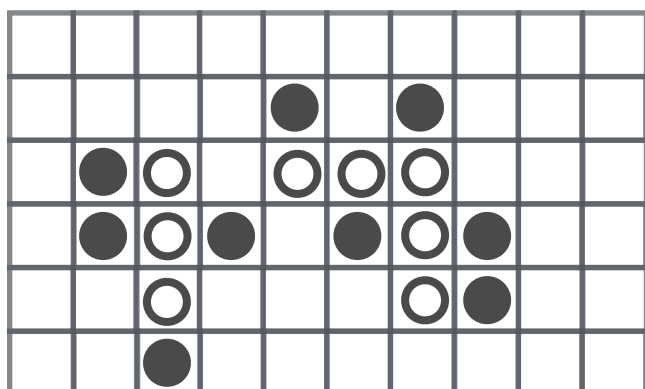


Still Life Boat (19 counters, hard):

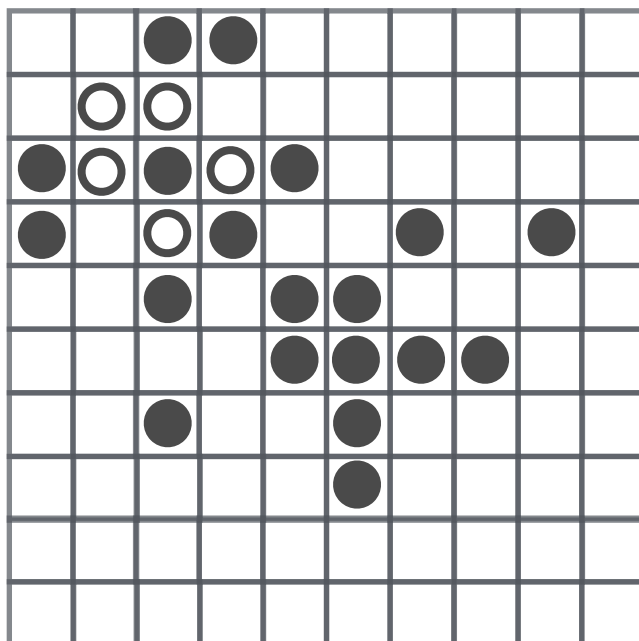


Solutions

Seventeen:



Still Life Boat:



References

1. E. R. Berlekamp, J. H. Conway and R. K. Guy III, Winning Ways (for your Mathematical Plays), Volume 2, Wellesley, MA: A. K. Peters, 2003.
2. M. Gardner, Wheels, Life and Other Mathematical Amusements, New York: W. H. Freeman, 1983.
3. Y. Elran, G4G7 Exchange Book, 2006, G4G11 Exchange Book
4. Y. Elran, Homage to a Pied Puzzler, E. Demaine, M. Demaine and T. Rodgers, Eds., Wellesley, MA: A. K. Peters, 2008, pp. 129-136.
5. Yossi Elran, "Retrolife and The Pawns Neighbors", The College Mathematics Journal, 43, 147 (2012), reproduced as a chapter in M. Henley (ed.) and B. Hopkins (ed.), "Martin Gardner in the 21st Century", MAA (2012)
6. C. Ashbacher, "Retrolife Generation of the Twelve Pentominoes," *Journal of Recreational Mathematics*, vol. 36, no. 1, pp. 35-41, 2007.
7. Game of Life simulation: <https://bitstorm.org/gameoflife/>
8. A special thanks to Neil Bickford for his open software: <https://nbickford.wordpress.com/2012/04/15/reversing-the-game-of-life-for-fun-and-profit/>

