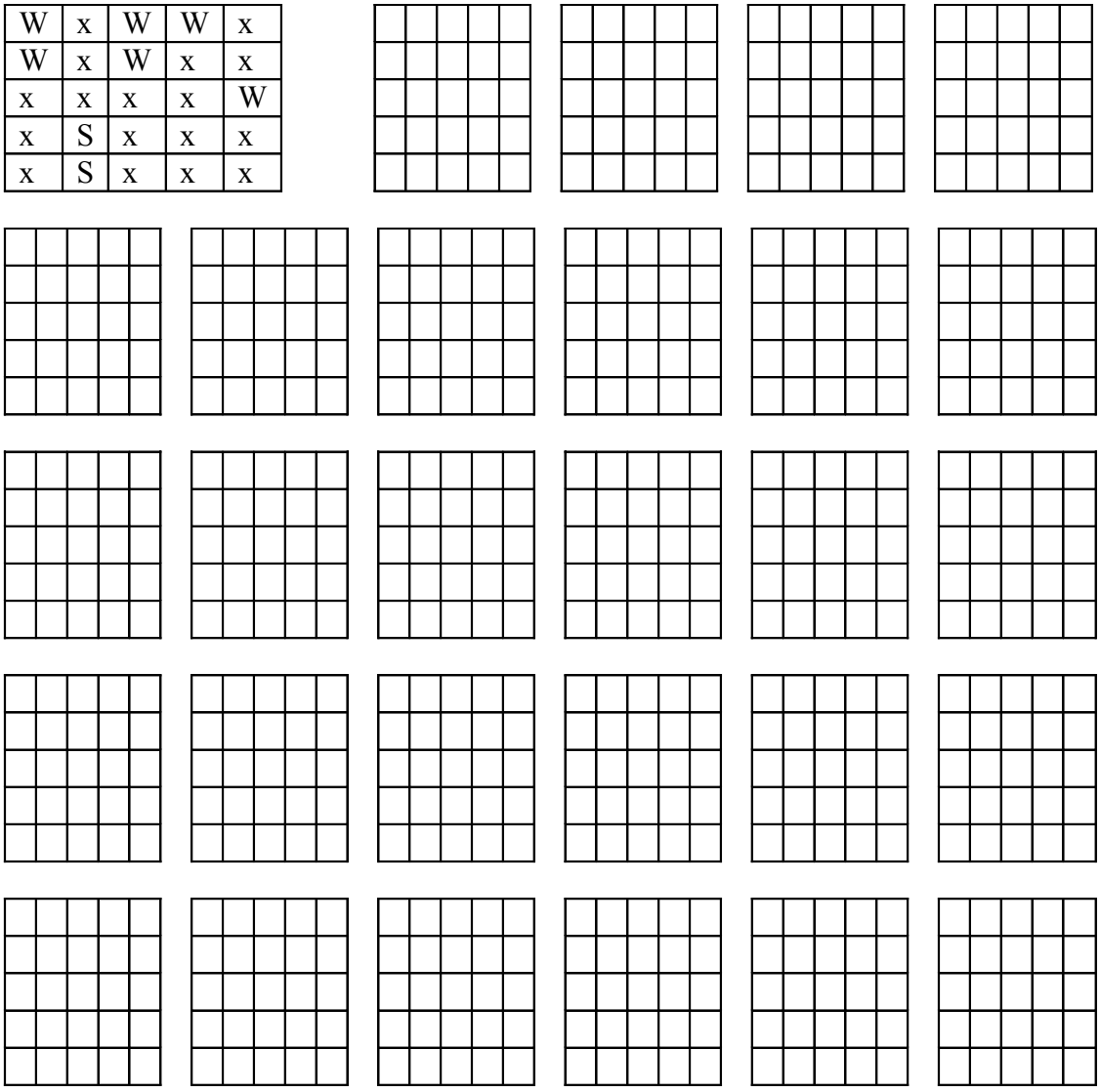
Julia Robinson Mathematics Festival

Directed By Joshua Zucker

Wolves and Sheep

Place 5 wolves on a 5 by 5 chessboard so that 3 sheep are safe. Wolves move like chess queens (any number of squares horizontally, vertically, or diagonally). A sheep is safe if no wolf can reach it in one turn. For instance, the first grid below shows a solution with 6 wolves and room for 2 sheep. The squares marked W are wolves, x marks the unsafe spaces, and S marks the two sheep spaces.

W	x	W	W	x
W	x	W	x	x
x	x	x	x	W
x	S	x	x	x
x	S	x	x	x



Additional Questions

1) Solve a simpler problem: How many sheep can fit with 0 wolves? 1 wolf? 2 wolves?

2) How many different ways are there to place the 5 wolves on the board? (ignoring the sheep)

3) How many different ways are there to place the 3 sheep on the board? (ignoring the wolves)

4) How many different solutions are there to the original problem? Can you prove your answer?

5) Generalize: How many sheep can fit with w wolves on an n by n board? Perhaps some special cases (small values of w and/or n) would be easier to answer to help get you started.