

The n -queens problem is to place n queens on an $n \times n$ chess board so that no two queens attack each other. We would like to represent this as a satisfiability problem.

We will represent an $n \times n$ chess board with a 2-dimensional array $[0 \dots n-1, 0 \dots n-1]$. There are n rows, n columns, $2n-1$ “down” diagonals, and $2n-1$ “up” diagonals.

- (1) Restate the n queens problem in English in terms of rows, columns, and diagonals (without the word “attack”).
- (2) In any solution of the n queens problem, what can you say about the number of queens in each row.
- (3) Restate the n queens problem in English in terms of rows, columns, and diagonals (without the word “attack”) using the answer to Question (2). (The new statement will be less elegant but more useful.)
- (4) Given a queen on square (i, j) , what (i) row squares, (ii) column squares, (iii) down diagonal squares, and (iv) up diagonal squares does it attack?
- (5) Write the 4-queens problem as a satisfiability problem.
- (6) Assume someone gives you a partial solution: I.e., they tell you that there are queens on squares $(i_1, j_1), (i_2, j_2), \dots, (i_k, j_k)$ (for some k). Explain how you would modify your solution to solve this version of the problem.