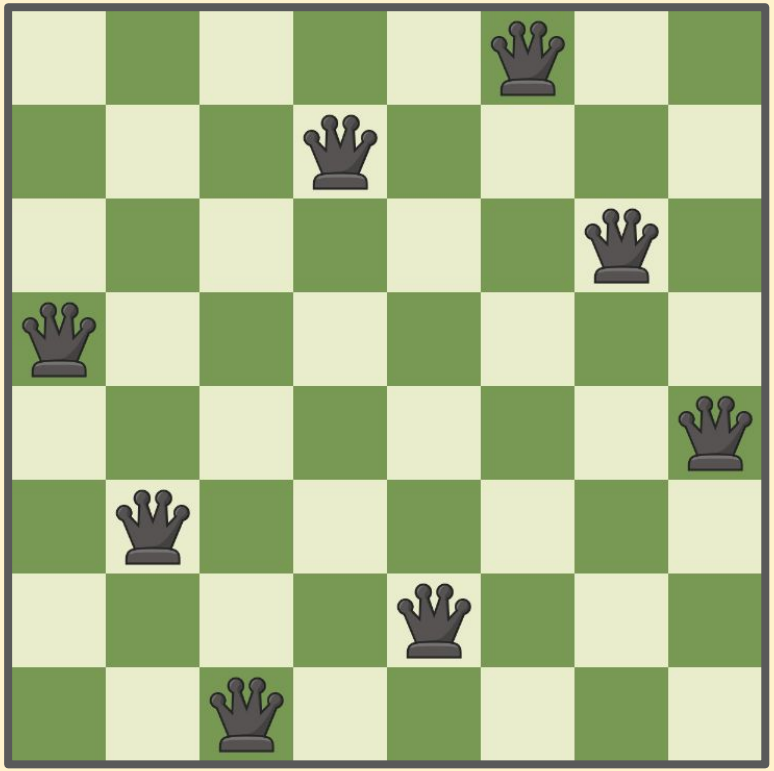
8-Queen Problem

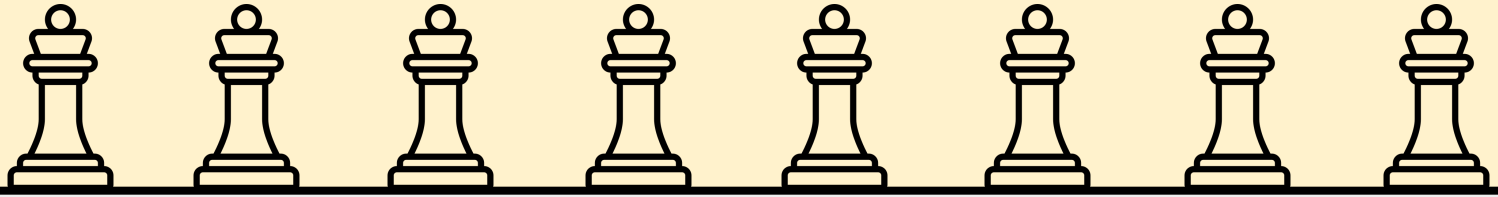
Shervin Iranaghideh
Ali Daneshgar

Understanding the **Challenge**

The problem involves placing 8 queens on an 8x8 chessboard in such a way that no two queens threaten each other. These queens, which can move horizontally, vertically, and diagonally, must be positioned without attacking one another.



Why Even **Bother?**



The 8-queens problem serves as a quintessential example in the domain of AI and problem-solving. Its complexity and constraints encapsulate the essence of various search algorithms and problem-solving strategies used in artificial intelligence.

Possible Arrangements

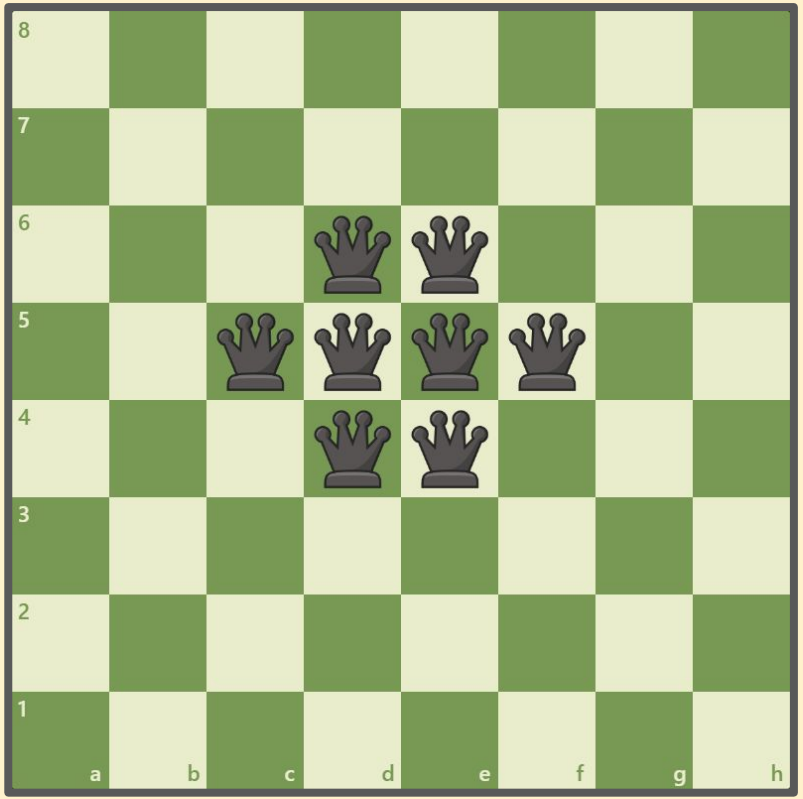
On a standard 8x8 chess board there are 64 possible slots for a piece. At our starting position, with each of the 8 queens taking up one space per each column, there are 56 available spaces for each queen to move to. And since each of the queens are interchangeable with one another, the total number of possible arrangements add up to:

$$\frac{64!}{56!8!}$$

Which is equal to 4,426,165,368 different arrangements!

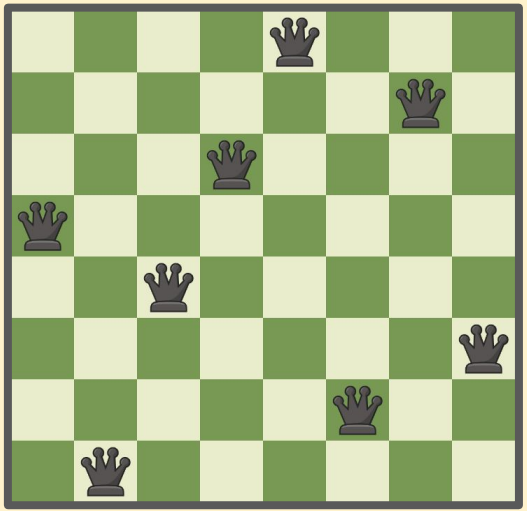
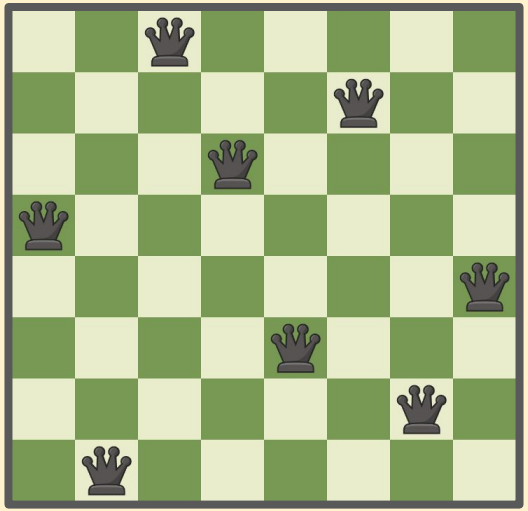
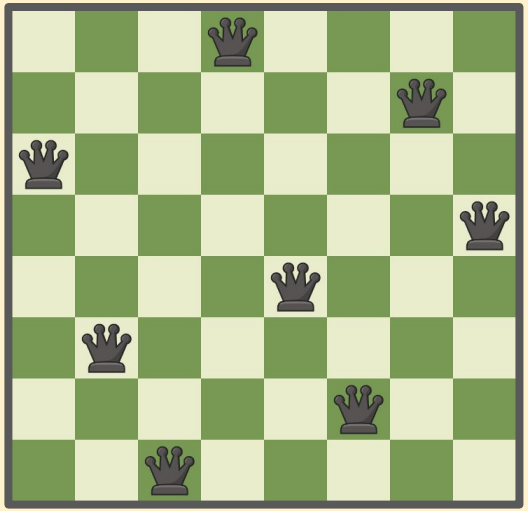
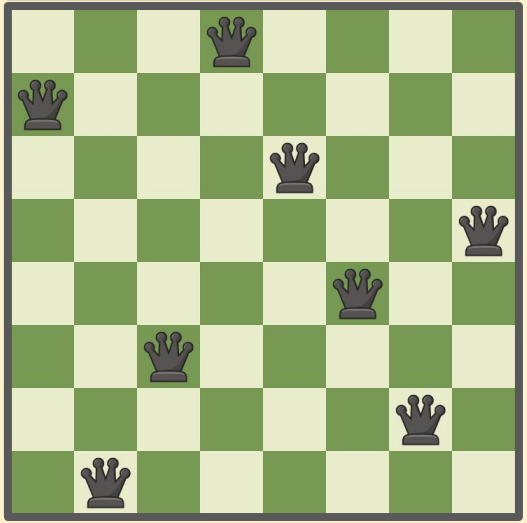
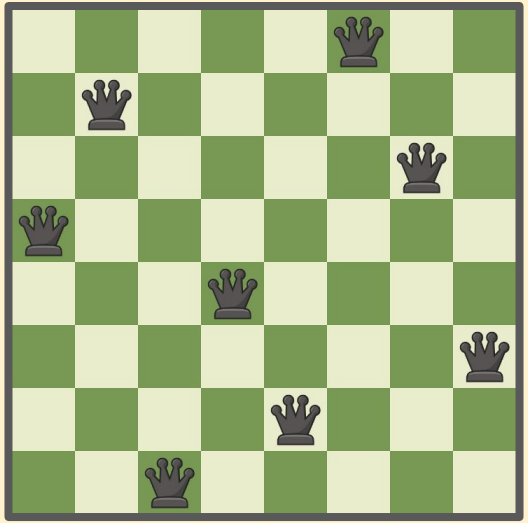
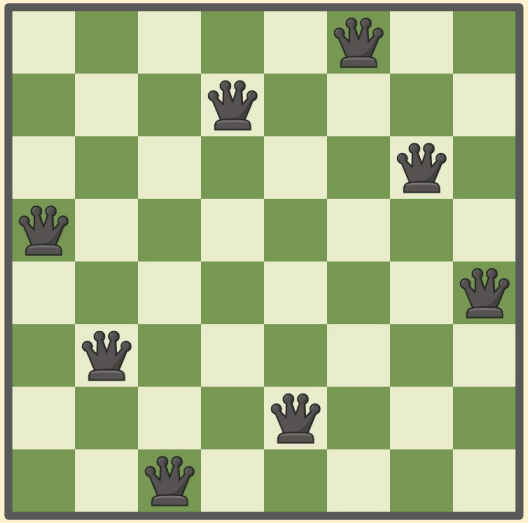
Looking for the a **Solution**

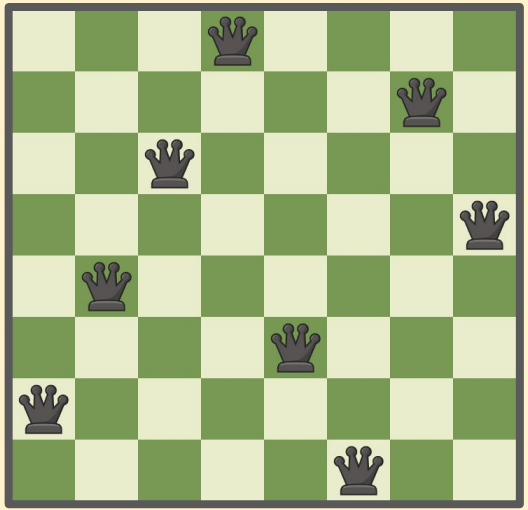
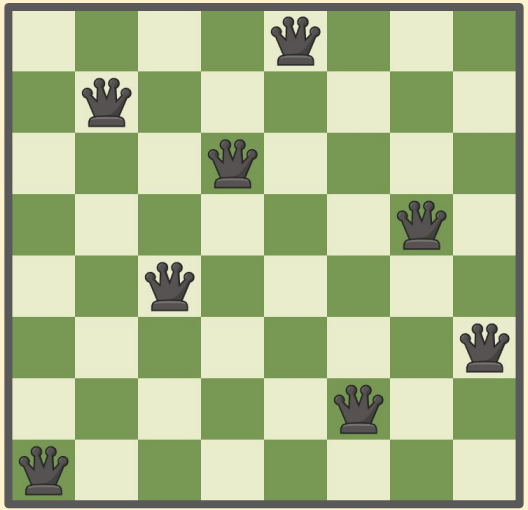
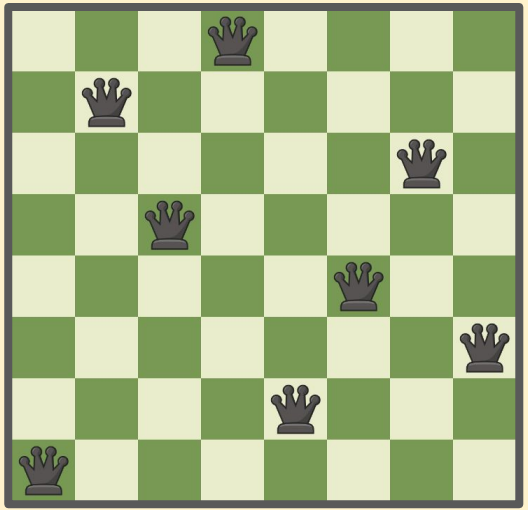
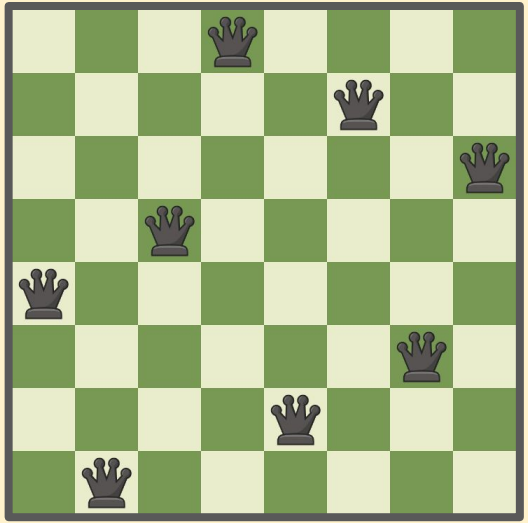
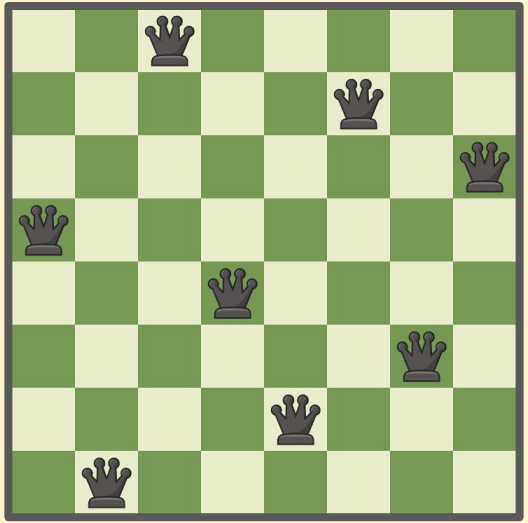
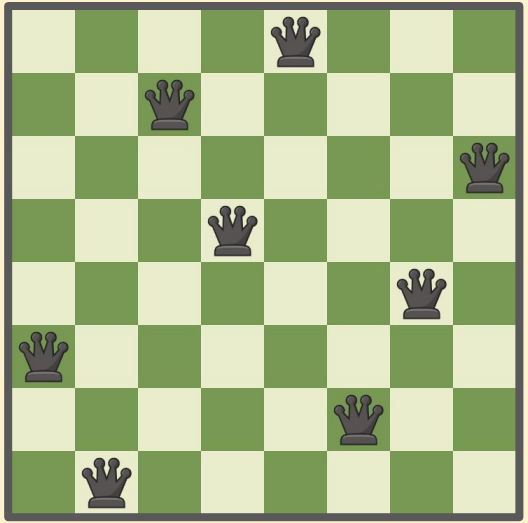
Out of all the different possible variations, only a handful will result in correct solutions. Infact, most of them result in obviously wrong answers. Like the one here:



Solutions

There are only **92** different distinct solutions. There are **12** fundamentally different arrangements, meaning they are NOT rotations or mirrors of other solutions. 11 of these unique solutions, can be both rotated and reflected to make 8 distinct solutions each, making up for 88 of the 92, and reflection and rotation of 1 of them can result in 4 distinct solutions.

Different Size Boards

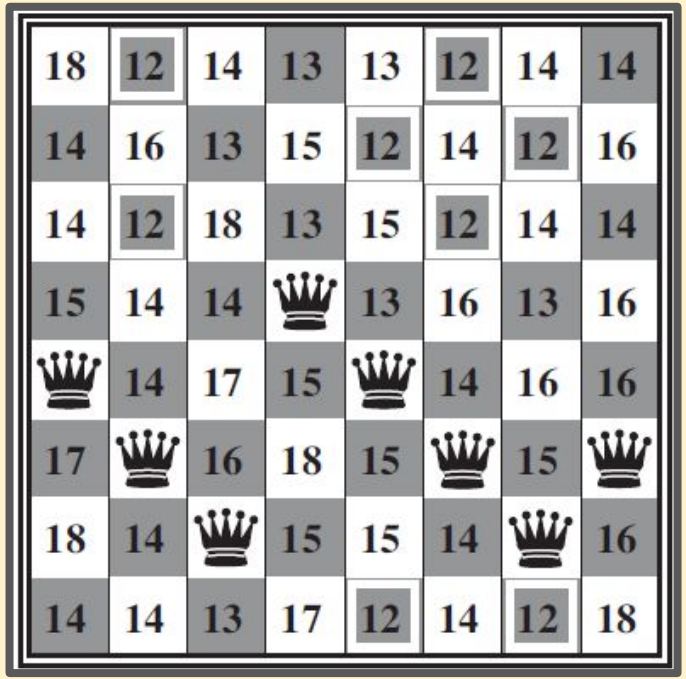
Board	Total Solution	Unique Solutions
1x1	1	1
2x2	0	0
3x3	0	0
4x4	2	1
5x5	10	2

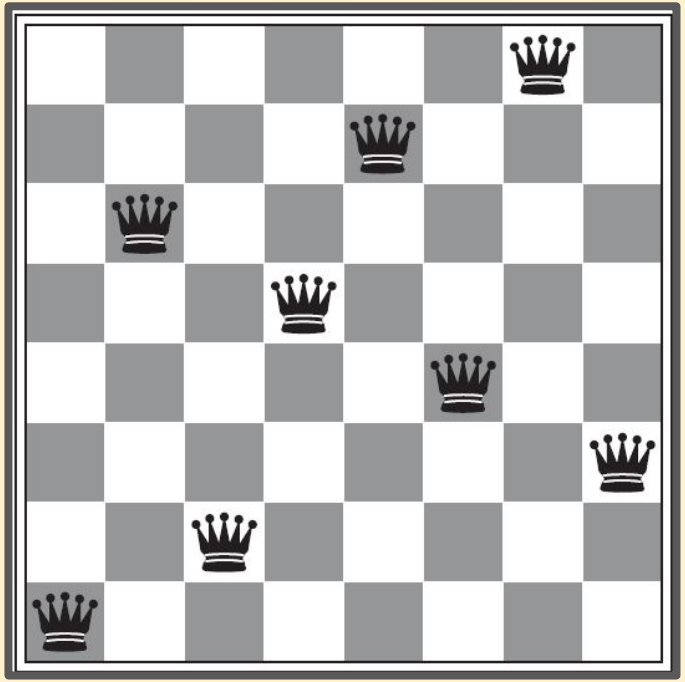
Board	Total Solution	Unique Solutions
6x6	4	1
7x7	40	6
8x8	92	12
9x9	352	46
10x10	724	92

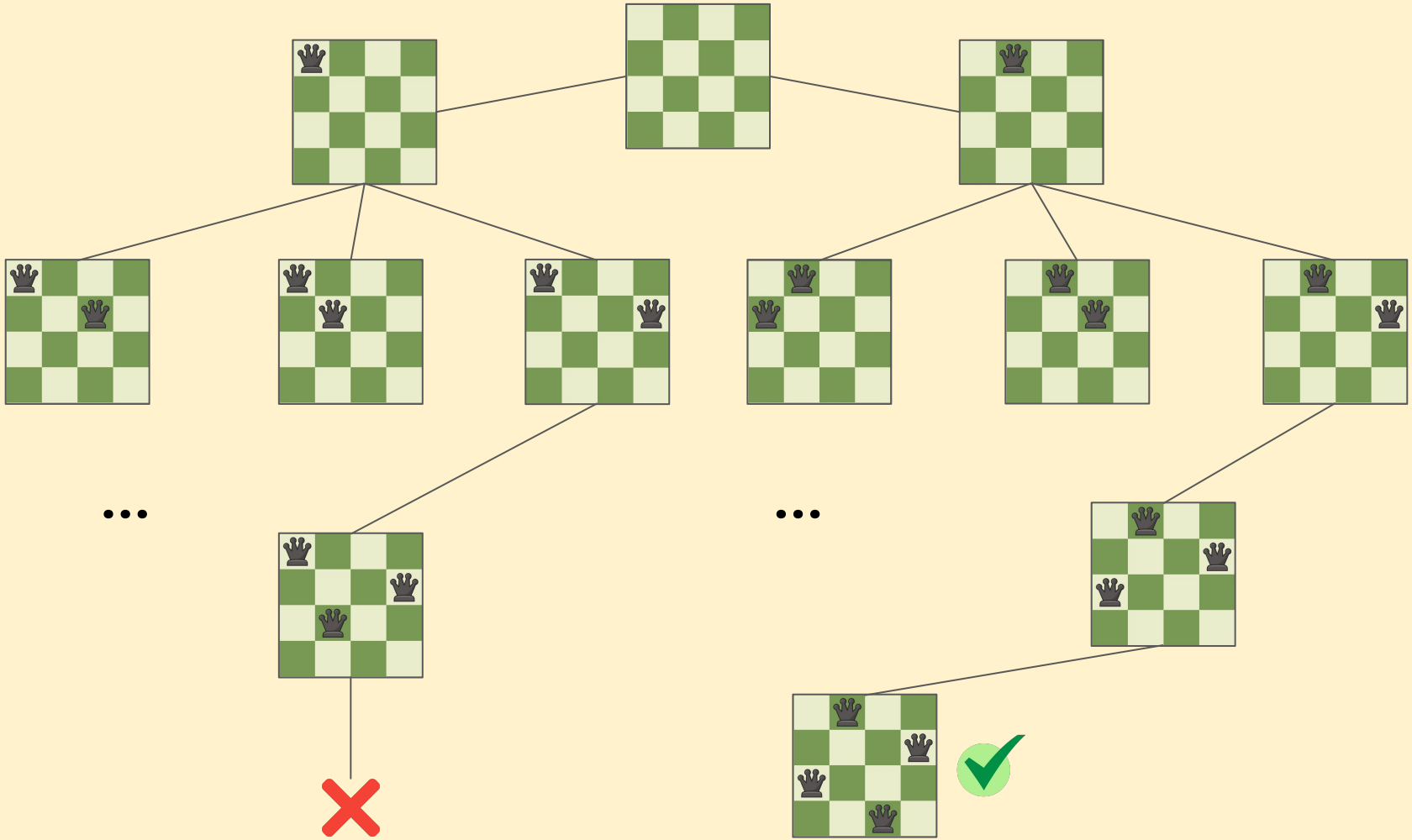
Algorithms for Solving 8-Queen

- Brute Force Search
- Backtracking
- Genetic Algorithms
- Hill Climbing
- Simulated Annealing

Hill Climbing







Good Luck!