H4: N Queens

Before you begin: this is a challenging assignment that might consume more time than you would expect, initially.

Write a program called `queens.cpp` that solves the N-queens puzzle. The problem is to place N queens on a N * N chess board such that no queen threatens any other queen. In essence, this means no two queens can be within the same row, column, or diagonal.

Please also see: https://en.wikipedia.org/wiki/Eight_queens_puzzle

Your program should ask the user how many queens to place on the board. (The same number determines the size of the board, too.) The number of queens must be an integer number larger or equal to 1. Print an error message for invalid input. With a valid number N given, try to place N queens and then either print a message that placement is impossible, or else print a chess board showing the queens.

For the chess board, use a vector of vectors of boolean values. Your program should follow the backtracking search algorithm that is animated towards the bottom of the wikipedia page. It works as follows:

0. start with an empty chess board

1. place a queen on the topmost row (starting in the leftmost column)
2. if the currently placed queen does not conflict with any previously placed queen:
   - recursively place the remaining queens in the remaining rows
   - if that placement failed due to conflicts, retract the queen in the current row and try the next column
3. if placement of a queen in all columns failed, return indicating failure

For N>3, there exists more than one solution to the problem. In order to find the same solution as our automated test, please try placing queens from top to bottom, and from left to right (according to how you print the chess board).

Hints:

1. Write a function
   `bool placeQueens(int N, vector < vector <bool> >& board, int row)`
   that recursively places the queens on the board. It returns true if a placement was possible.
2. There is no need to handle the cases N=2 and N=3 explicitly. The function will find out by itself that there is no solution.

Correct runs of the program are shown below:

```
How many queens to place on the board? foo
error: invalid input
```

```
How many queens to place on the board? 0
error: invalid input

How many queens to place on the board? 2
No solution found to place 2 queens on a 2 by 2 chess board

How many queens to place on the board? 4
.Q..
...Q
Q...
..Q.
```