SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF INFORMATION TECHNOLOGY

19ITB201 – DESIGN AND ANALYSIS OF ALGORITHMS

II YEAR IV SEM

UNIT-V-COPING WITH THE LIMITATIONS OF ALGORITHM

TOPIC: Backtracking –N Queen's Problem

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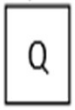
Backtracking

- Construct the *state-space tree*
  - nodes: partial solutions
  - edges: choices in extending partial solutions
- Explore the state space tree using depth-first search (dfs)
- "Prune" *nonpromising nodes*
  - dfs stops exploring subtrees rooted at nodes that cannot lead to a solution and backtracks to such a node's parent to continue the search

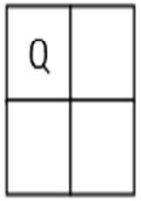
N-Queen Problem

The problem is to place n queens on an $n \times n$ chessboard so that no two queens attack each other by being in the same row or in the same column or on the same diagonal.

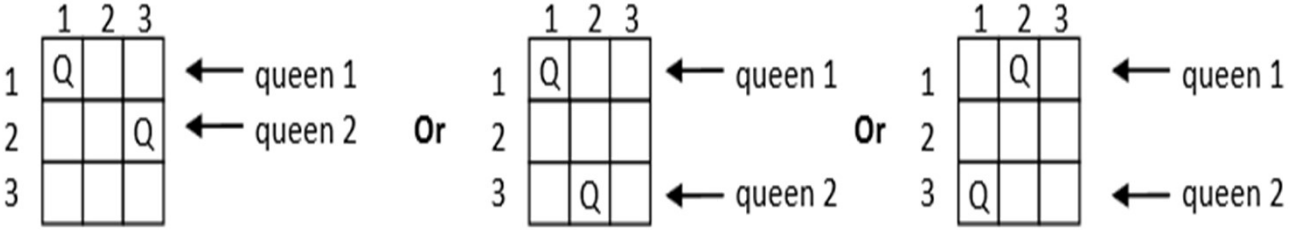
For $n = 1$, the problem has a trivial solution.



For n = 2, it is easy to see that there is **no solution** to place 2 queens in 2×2 chessboard.

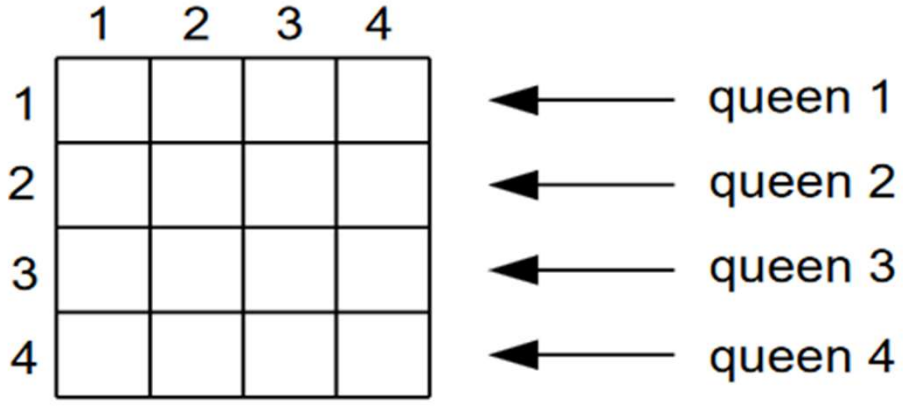


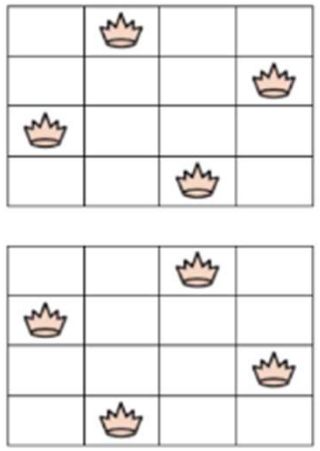
For $n = 3$, it is easy to see that there is **no solution** to place 3 queens in 3×3 chessboard.



N-Queen Problem

- **The *n*-queens problem**: is to place n queens on an n-by-n chess board so that no two queens attack each other by being in the same row, or in the same column, or on the same diagonal.
- Solution $x = (x_1, x_2, x_3, x_4) = (2, 4, 1, 3)$

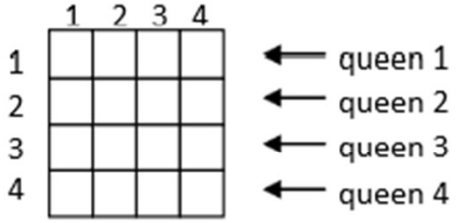




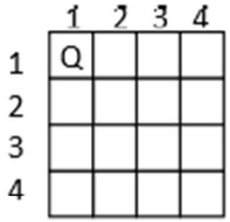
4-Queen Problem

For $n = 4$, There is **solution** to place 4 queens in 4×4 chessboard. the four-queens problem solved by the backtracking technique.

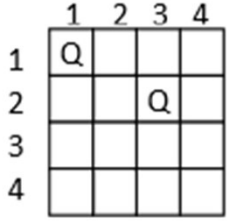
Step 1: Start with the empty board



Step 2: Place queen 1 in the first possible position of its row, which is in column 1 of row 1.

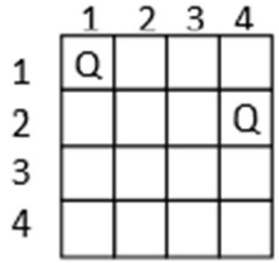


Step 3: place queen 2, after trying unsuccessfully columns 1 and 2, in the first acceptable position for it, which is square (2, 3), the square in row 2 and column 3.

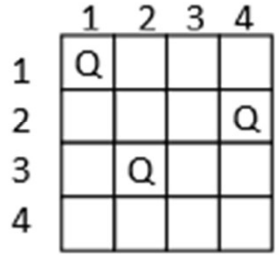


4-Queen Problem

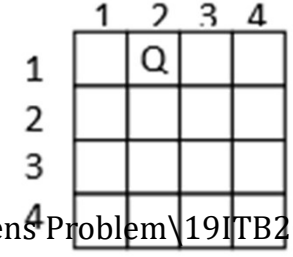
Step 4: This proves to be a dead end because there is no acceptable position for queen 3. So, the algorithm backtracks and puts queen 2 in the next possible position at (2. 4).



Step 5: Then queen 3 is placed at (3, 2), which proves to be another dead end.

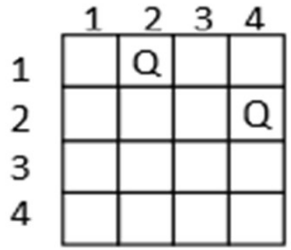


Step 6: The algorithm then backtracks all the way to queen 1 and moves it to (1, 2).

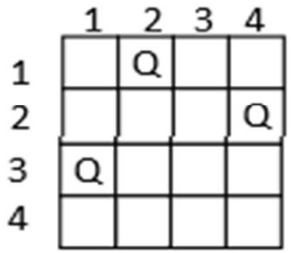


4-Queen Problem

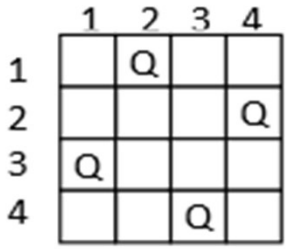
Step 7: The queen 2 goes to (2, 4).



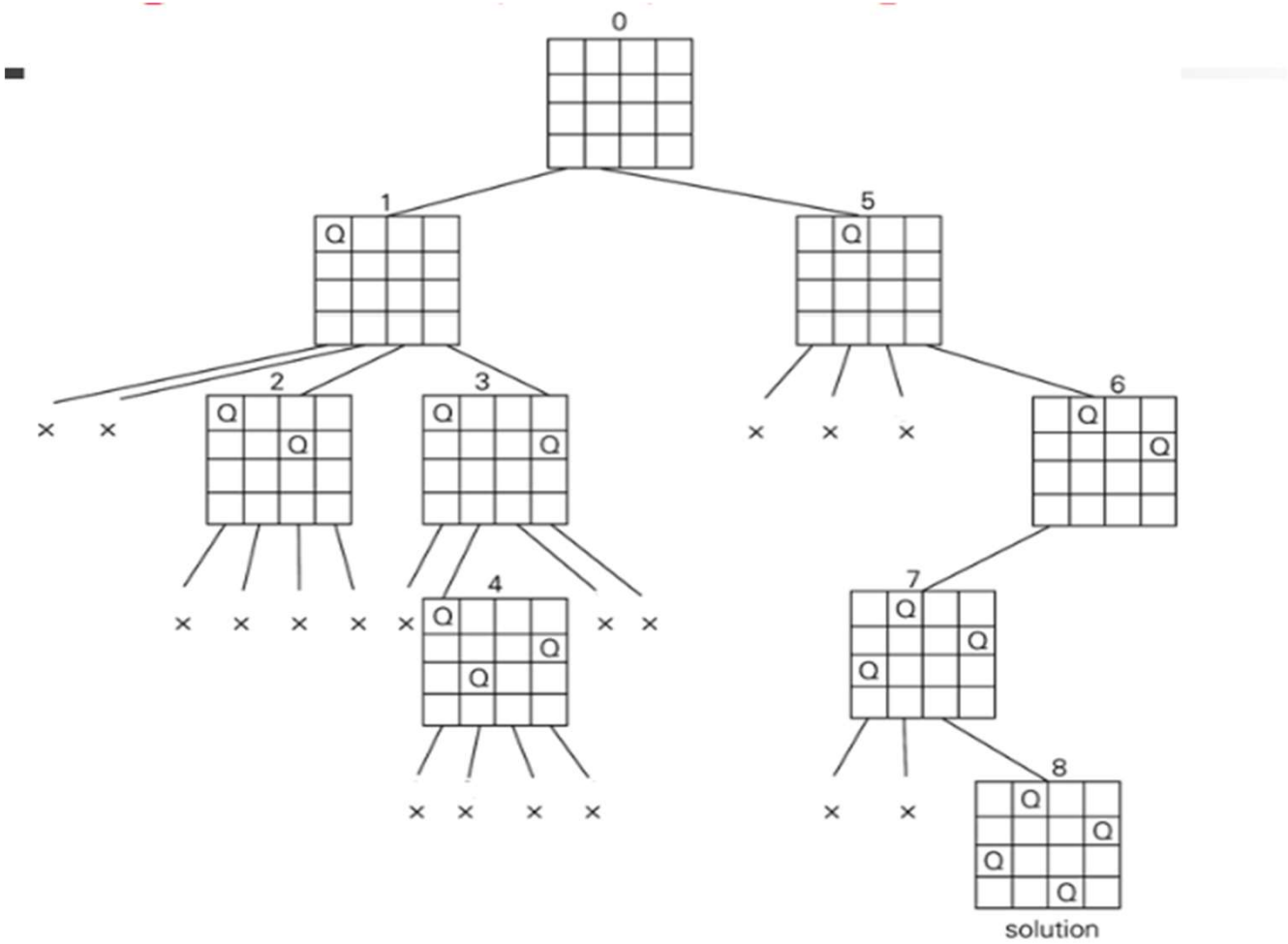
Step 8: The queen 3 goes to (3, 1).



Step 9: The queen 3 goes to (4, 3). This is a solution to the problem.



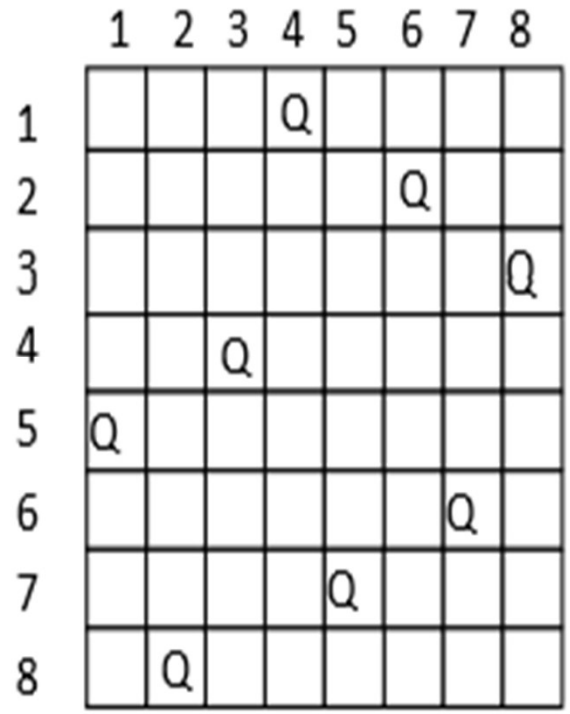
Solution for 4 Queens Problem



Solutions: (2, 4, 1, 3) and (3, 1, 4, 2) (reflection)

State Space Tree of 8 Queens Problem

For $n = 8$, There is **solution** to place 8 queens in 8×8 chessboard.



Assessment

1.In how many directions do queens attack each other?

a)1
b)2
c)3
d)4

2. Where is the n-queens problem implemented?
a)Carom
b)Chess
c)Ludo
d)Cards


Thank You