

The 8 Queens Problem:

The n queen's problem can be stated as follows. Consider a $n * n$ chessboard on which we have to place n queens so that no two queens attack each other by being in the same row or in the same column or on the same diagonal

Steps for implementing 8-Queens problem:

Step 1 : N Queens problem can be executed for the values of n as 4 or 8

Step 2 : We should place the first queen at the location of (1,1) after constructing a $4 * 4$ chess board for 4 queens problem and $8 * 8$ chessboard for 8 queens problem

Step 3: Place the second queen by obeying the rules such as

- a) Second queen placed should not intersect the row of the first queen
- b) The second queen placed should not intersect the column of the first queen
- c) The second queen placed should not intersect diagonally of first queen

Step4: The first queen should be placed in first row, second queen in the second row and so on

Step5: After a successful three queen placements we will be forced to a situation such that the fourth queen should not be placed upon the rules

Step6: To solve this problem we understand that as the fourth queen is not placed and the placement of the fourth queen is unsuccessful because of improper placement in the previous steps such as placing the queen in position 3,2,1

Step7: So we backtrack and check over the placement of queens and adjust the third queen such that 4th queen can be placed based on the rules

Step8: If the third queen is placed in correct position and 4th queen cannot be placed based on rules we go one step backward such as to the placement of queen 3,2,1 to make successful placement of all queens based on the rules

Step 9: The process is continued till we make all queen as successful placement

Step 10: After having a successful placement of the entire queen we will draw a state space graph based on the successful placement

Step11: Same steps can be used for 8*8 chessboards by increasing the placements of 4 to 8

Implementation of 4 Queens problem:

- ❖ Start with a empty chess board
- ❖ Place the queen 1 in the first possible position of its row (i.e.) on the first row and first column

Q			

- ❖ Then place queen 2 after trying unsuccessful place (2,1),(2,2) because as per rules we should not place elements in the same row or same column and same diagonal

Q			
		Q	

- ❖ There is a dead end for 3rd queen because it cannot be placed in the 3rd row as there is no acceptable position for queen 3 to be placed based on the rules. Hence the algorithm backtracks and places 2nd queen at (2,4) position

Q			
			Q

- ❖ Then we can place the third queen at (3,2) position but it is another dead end as the 4th queen cannot be placed at the 4th row according to the rules

Q			
			Q
	Q		

- ❖ Hence we back track all the way up to the queen 1 and move it up to (1,2)
- ❖ After performing all the back tracking operation we place queen 1 at (1,2) , queen 2 at (2,4) , queen 3 at (3,1) and queen 4 at (4,3)

	Q		
			Q
Q			
		Q	

Implementation of 8 Queens problem:

- ❖ Initially the chess board is empty
- ❖ By performing the rules we can place 5 queens successfully such that no queens can attack each other based on the rules

	Q						
			Q				
Q							
		Q					
				Q			

- ❖ Now we cannot place the queen 6 based on the rules .If we place the queen 6 at the location (6,6) 5th queen will be affected and if queen 6 is placed at the location (6,7) then queen 1 can attack. if queen 6 is placed at (6,8) queen 2 will attack. Similarly At (6,5) the Queen 5 will attack ,at (6,4) the queen 2 will attack, at (6,3) the queen4 will attack, at(6,2) the queen 1 will attack and at (6,1) queen3 will attack. This shows we need to back track and change the previously placed queen positions.
- ❖ Hence we back track we adjust with the already placed queens

Q							
							Q
					Q		
		Q					
						Q	
	Q						
			Q				

- ❖ But again Queen 8 cannot be placed at empty position safely.Hence we need to backtrack. Finally the successful placement of all the eight queens can be given below

		Q					
					Q		
	Q						
						Q	
Q							

			Q				
							Q
				Q			

State Space Tree For 4 Queens Problem:

