Assignment 5

Rajdhani
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Title :- N-Queens matrix using backtracking

Aim :-

Design N-Queens matrix having first queen player. Use backtracking to place remaining queens to generate the final N-queens matrix.

Objectives:-

1) To understand N-queens problem.
2) To understand backtracking for placing queens.

Pre-requisites :-

Knowledge of DSA

Theory :-

N-queens problem is to place N-queens in such a manner on an nxn chessboard that no two queens attack each other by being in the same row, column or diagonal.

It can be seen that for n=1, the problem has a trivial solution and no solution exist for n=2 & n=3.
So let's consider 4x4 chess.

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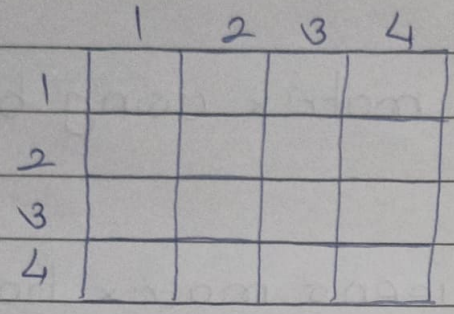


4×4 chessboard.

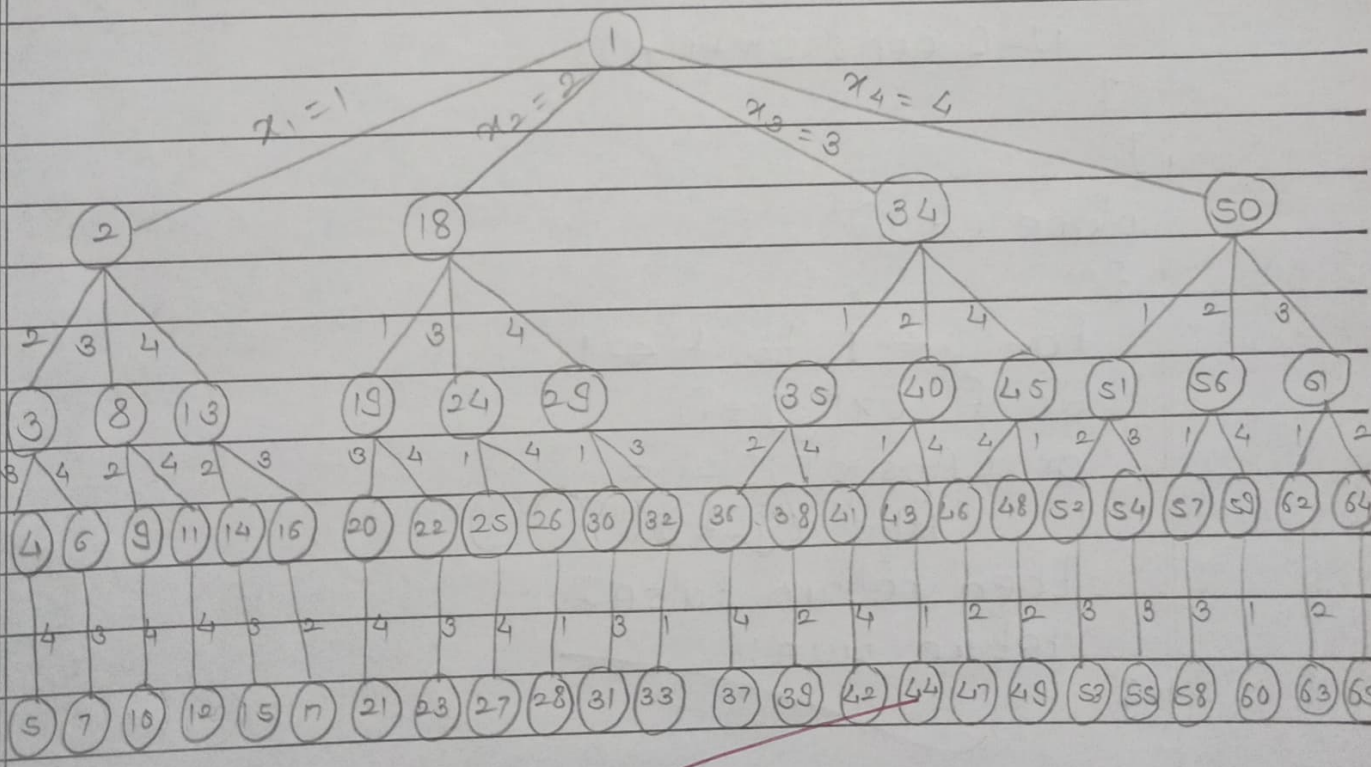
Now, we place q_1 in every first acceptable position.
Next, we put queen q_2 so that both of these queens do not attack each other, we find if we place q_2 in column 1 and 2, then the dead end is countered. Thus, the first acceptance position for q_2 in column 3 i.e. (2,3) but, there is no position left for placing queen q_3.
So, we backtrack one step and place the queen q_2 in (2,4) the next best possible solution, then we obtain position for placing q_3 which is (3,2)
So, at the end solution found as -
(2,4,1,3) & (3,1,4,2)

Here is solution for 4×4 matrix queen as no two queens should be in same row, column or diagonal.

	1	2	3	4
1			Q_1	
2	Q_2			
3				Q_3
4		Q_4		

	1	2	3	4
1		Q_1		
2				Q_4
3	Q_3			
4			Q_4	

The implicit tree for 4-queen problem for a solution (2,4,1,3) is as follows.
Also we will see all the solutions to the 4 queen problem can be represented as.



Place (k,i) return true if a queen can be placed in the k^{th} row and i^{th} column, otherwise return false.
x[] is a global array whose final k-1 values have been set. Abs(r) returns the absolute value of r.

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Code for placing (k,i) in N-queens problem.

```
N-Queens (k, n)
{
 for i<-1 to n
    do if place (k,i) then
{
   x [k] <- i;
   if (k==n) then
      write (x [1---n]);
   else
   N-Queens (k+1, n);
 }
}
place (k,i)
{
 for j<-1 to k<-1
 do if (x[j] =i)
 or (Abs x [i] -i =
       Abs (j-k)
 then return false;
  return true;
}
```

Conclusion:-

Hence, we understood how to place N-queens in a number of matrix by using backtracking.