SNS COLLEGE OF ENGINEERING

Coimbatore-107

COURSE NAME: ANALYSIS OF ALGORITHM

II YEAR/ IV SEMESTER

UNIT – V

BACKTRACKING ALGORITHM

Topic

N-Queen's Problem

Page

UNIT – V BACKTRACKING METHOD

*. We search for set of solution (or) optimal solution that satisfy some constraint using Back track formulation.

$$\text{Solution} = (x_1, x_2 \ldots x_n)$$

x_i is chosen from this set which is best.

Note:

Search is refined at each stage by eliminating certain possibilities.

Exhaustive Search:

It is basic routine of search in which all possible solutions to the given problem are produced.

State Space Tree:

In backtracking while solving a given problem, a tree is constructed based on choices made. Such a tree with all possible solutions is called state space tree.

'N' Queens problem:

4 Queen is solvable & it should meet in
→ No Rows
→ No Column
→ No Diagonal.

Step 1

Place Q_1 in (1,1)

	1	2	3	4
1	Q_1			
2				
3				
4				

Step 2:

Place Q_2 in 2^{nd}

Col Hit (2,1) ✗

Diag Hit (2,2) ✗

No Hit So (2,3) ✓ place

	1	2	3	4
1	Q_1			
2			Q_2	
3				
4				

Step 3: ✗

Q_1			
		Q_2	

Q_3 → Cannot be placed

Dead end; So Back

Step 3:

Place Q_3 by checking if it hits diagonal, Row (or) column. (3,2) is correct to place Q_3

	1	2	3	4
1	Q_1			
2				Q_2
3		Q_3		
4				

← Place Q_3 again.

Step 4: Place Q_4

Check Q_4 to place in Row 4; But it hits in diag, Row & col. occurs

	1	2	3	4
1	Q_1			
2				Q_2
3		Q_3		
4				

Q_4 cannot be placed; Dead; So Back track

~~to~~ Q_1 & Relocate it.

Steps:

Now Q_1 relocated to (1,2) & again check Q_2, Q_3 & Q_4 to place.

	Q_1		
			Q_2
Q_3			
		Q_4	

No crossing.
& so placed all without crossing each other

Placing : Q_1 (1,2), Q_2(2,4) Q_3(3,1) and Q_4 (4,3) solution can be obtained.

Algorithm:

```
Queen(n)
for col ← 1 to n do
{
  if (place (row, col)) then
  {
    board [row] column
    if (row = n) then
    print board (n)
    else
    Queen (row+1, n)
  }
}
```

It is because it ... either in row, c... ...

2 Queens problem →

Q_1	
	Q_2

X

3 Queens problem

Q_1		
		Q_2
	Q_3	

X

Both cannot be solved.

Time complexity

O(N!) ⇒

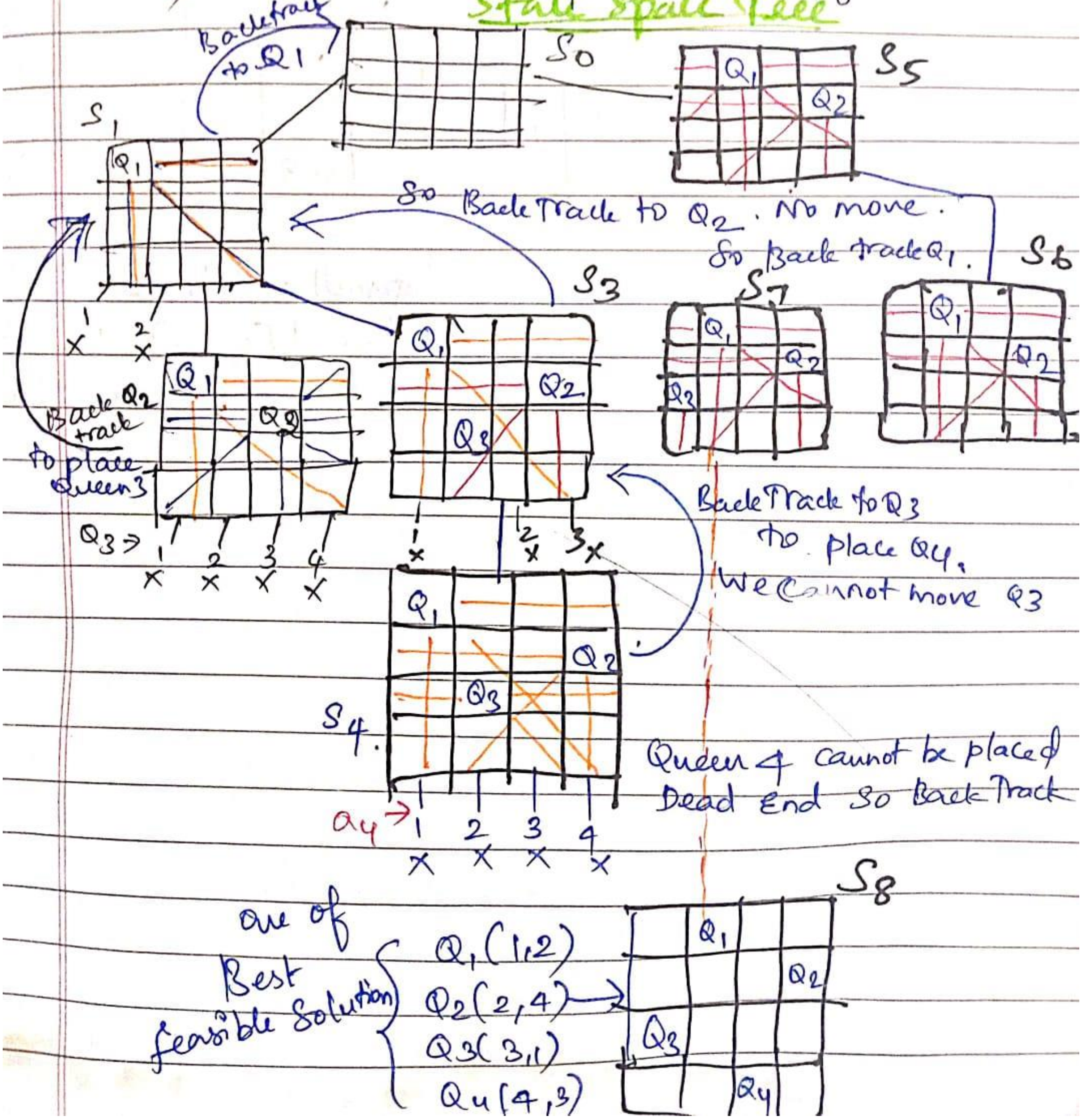
(i) Promising Nodes: → lead to solution

(ii) Non promising Nodes: → Leads to no Solution. (Dead End)

Space complexity:

O(N) → To store positions of Queens

State Space Tree



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Algorithm & Analysis of N Queens pu

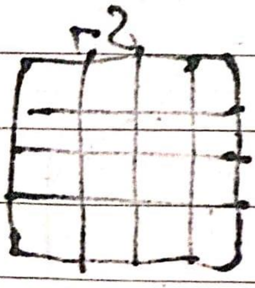
Algorithm solve N Queens (n)
{
board [n][n] = 0
place Queen (board, row=0)
if (place Queen returns true
Print (" Solution found").
else
Print (No Solution);
}

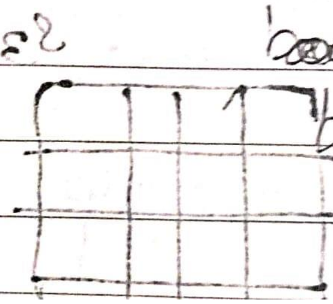
Time Comple
O(N!) → fo each row; Tr all possible
Space Comple
O(N) → Single Solut
O(N*K) → fo Storing all Solutions

Algorithm placeQueen (board, row)
{
if (row ≥ n)
return true // Queens placed Succes
for (col from 0 to n-1
if ((Is Safe (board, row, col) == true
place queen at board [row] [col] = 1
if place queen(board, row +1) } return true)

8 Queen's Solution.

	1	2	3	4	5	6	7	8
1		Q_1						
2				Q_2				
3						Q_3		
4								Q_4
5					Q_5			
6	Q_6							
7			Q_7					
8							Q8	





board[4][4]=0

board[0][0]=1

is_safe(row,c