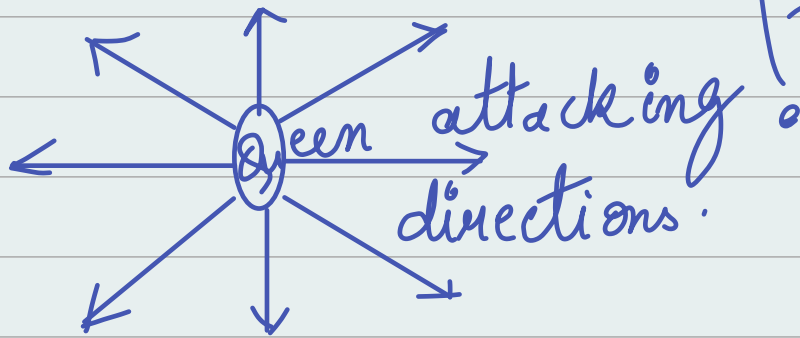


## Q1) N-Queens Problem

Display how many ways we can do this, & find the total number of ways



Thought Process!  
Doubts: How do we know this is recursion? How is this backtracking?

$N=4$

place 4 Queens on it

place 4 queens on the board such that no 2 queens are eliminating each other.

Q			
	X	Q	
cannot add Q	cannot add Q	X	X
←	Q	X	↖

cannot add

Recursion call for this did not work out. Move out of recursion call and Backtrack

In the above board we cannot place the 4<sup>th</sup> Queen so again backtracking and replacing the 2<sup>nd</sup> Queen to new position.  
Backtracking

Recursion call

<del>Q</del>	x	X	X
x	x	X	<del>Q</del>
x	<del>Q</del>	X	x
x	x	X	<del>Q</del> x

backtrack

backtrack

main() one of the ans

(board, n, c)

(0,0) (0,1) (0,2) (0,3)

(1,0) (1,1) (1,2) (1,3)

0	1	2	3
x	<del>Q</del>		
x	x	x	✓ <del>Q</del>
<del>Q</del> ✓	x	X	x
x	x	<del>Q</del> ✓	x

one of the possible answers

backtrack

(2,0) (2,1) (2,2) (2,3)

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

possibility of placing Queens in every single first box

recursion call

Recursion for 1<sup>st</sup> level Queen  
call for 2<sup>nd</sup> level Queen

(3,0) (3,1) (3,2) (3,3)

[illegible]

[Total length - column - 1]

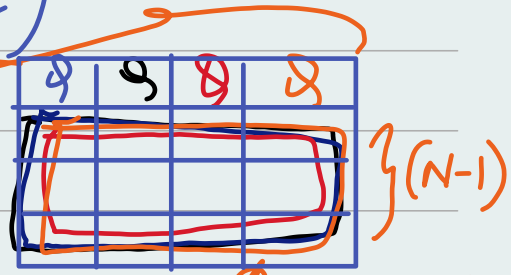
2) Here the column is 3 but total length is 2. Condition violated.

So here we have to take row = 2  
1 e. row

From the above condition we understand

that we have to take minimum of  
 $(row, col)$  for L.H.S  
 i.e.  $\min(r, c)$

\* Recurrence Relation:



$$T(N) = N * T(N-1) + O(N^2)$$

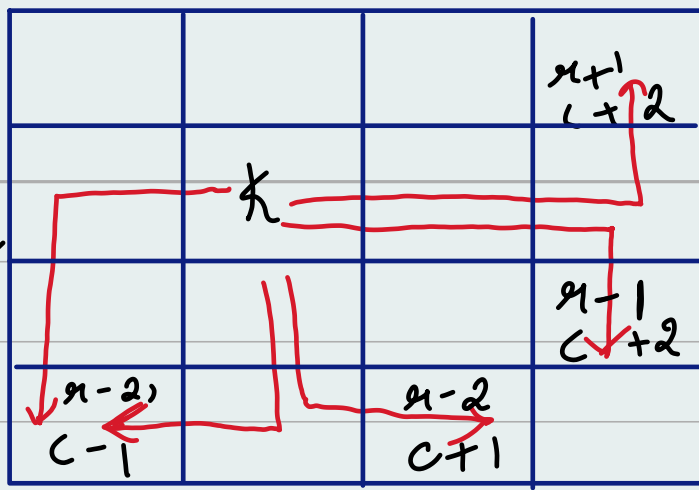
Akya Bajji formula:

$$O(N^3 + N!) \Rightarrow O(N!)$$


4  
3  
2  
3

$\Rightarrow 4!$   
 $=$   
 $\Rightarrow 4 \times 3 \times 2 \times 1$

\* N-knight problems.



(board, row, col, target)

	0	1	2	3
0	K	K ✓	K ✓	K ✓
1				
2				
3				

(0, 0, 4) ↓  
 (0, 1, 3) ↓  
 (0, 2, 2) ↓  
 (0, 3, 1) ↓  
 (0, 4, 0)

one of the ans is found

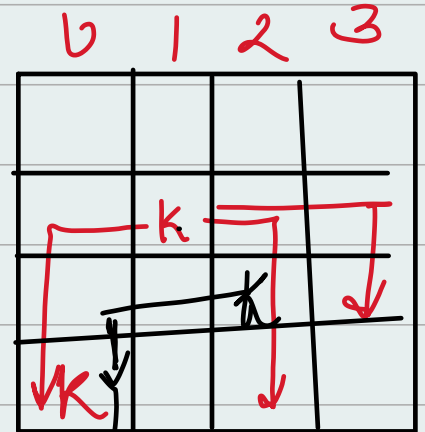
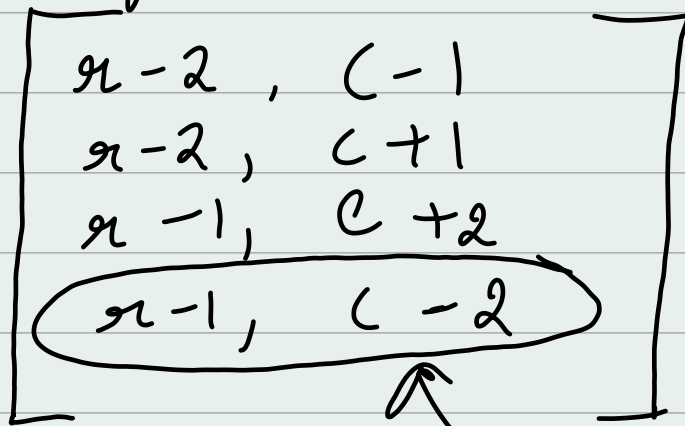
→ via backtracking it will try to find a new ans.

// next possible ans

	0	1	2	3
0	K ✓	-K ✓	-K ✓	
1	X ✓	K ✓		
2				
3				

(0, 0, 4) ↓  
 (0, 3, 1) ↓  
 (0, 2, 2) ↓  
 (1, 1, 1)

Is Safe check condition:-



\* Note : When a choice can effect future answers use backtracking.

