Queen Combination - 2D as 1D - Queen chooses

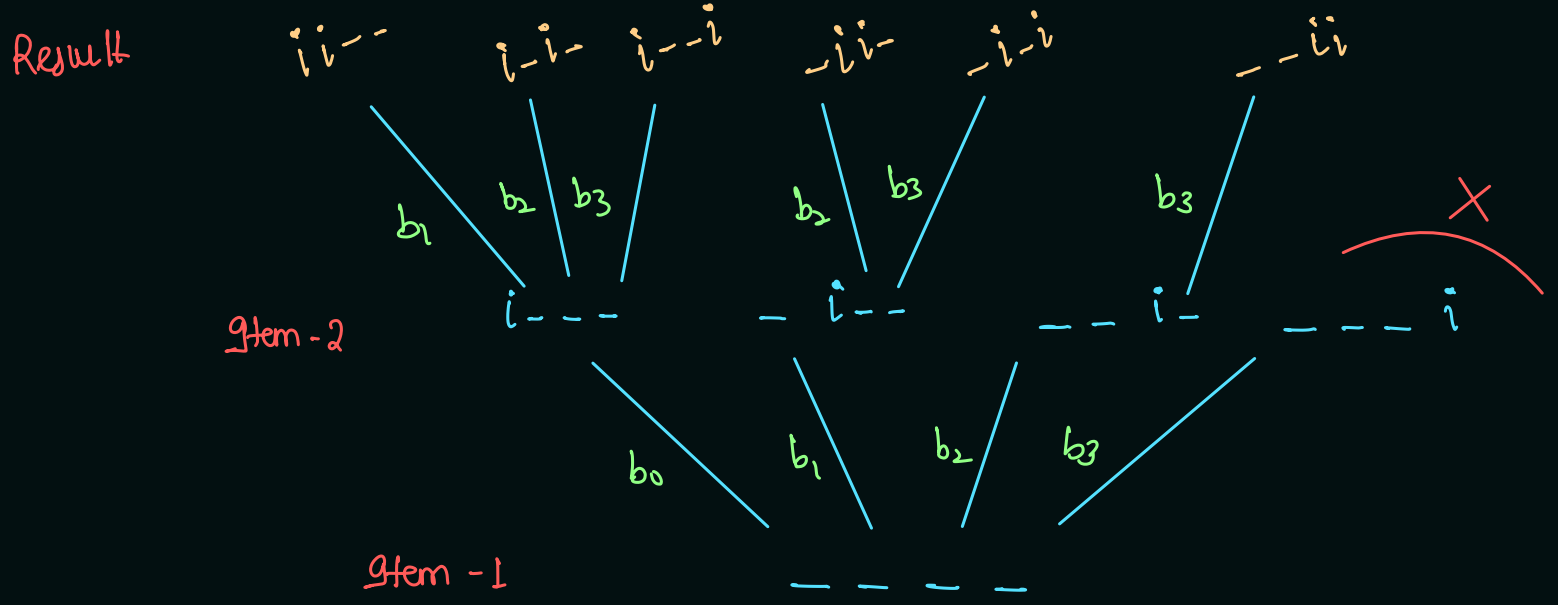
level → queen
options → box

Combination → Identical items
↳ print all possible ways

$n = 4$, $r = 2$
box, item

$$^4C_2 = \frac{4!}{2!2!} = \frac{^2\cancel{4} \times 3 \times \cancel{2!}}{\cancel{2!} \times \cancel{2!}} = 6$$

i i - -
i - i -
i - - i
- i i -
- i - i
- - i i



	0	1	2	3
0	0	1	2	3
1	4	5	6	7
2	8	9	10	11
3	12	13	14	15

Cells → 0 to m×n−1

(2,1) → 9

$$\text{row no} = \frac{\text{cell no.}}{\text{Total Column}}$$

$$\text{Col. no} = (\text{cell no } \%. \text{ Total Col.})$$

Eg →

	0	1	2	3	4
0	0	1	2	3	4
1	5	6	7	8	9
2	10	11	12	13	14

(0,0) 0	(0,1) 1	(0,2) 2	(0,3) 3
(1,0) 4	(1,1) 5	(1,2) 6	(1,3) 7
(2,0) 8	(2,1) 9	(2,2) 10	(2,3) 11
(3,0) 12	(3,1) 13	(3,2) 14	(3,3) 15

How to find row & column from cell no. OR box no →

$$\text{row} = \frac{\text{Cell no.}}{\text{Total colum.}}$$

$$\text{Colum} = \text{Cell no } \%. \text{ Total col}$$

11 → (2,1)

$$r = \frac{11}{5} = 2$$

$$c = 11 \%. 5 = 1$$

13 → (2,3)

$$r = \frac{13}{5} = 2$$

$$c = 13 \%. 5 = 3$$

9 → (1,4)

$$r = \frac{9}{5} = 1$$

$$c = 9 \%. 5 = 4$$

	0	1
0	0	1
1	2	3

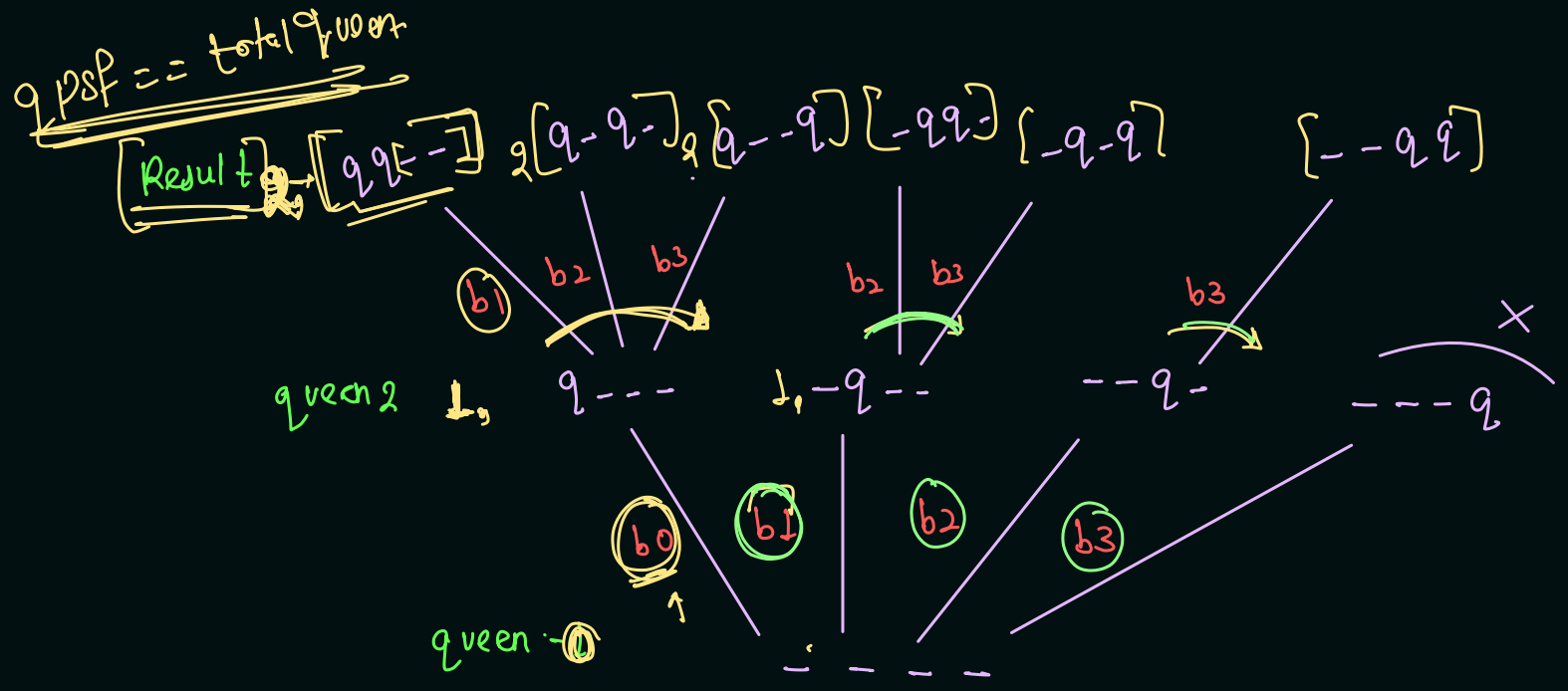
queen = 2 (identical)

boxes = 4.

no. of possible ways $= {}^{4}C_{2} = \frac{4!}{2!\,2!} = \frac{4\times3\times2!}{2!\times2!} = 6$ ways.

level → queens Result → $\begin{bmatrix} q & q \\ - & - \end{bmatrix}$ $\begin{bmatrix} q & - \\ q & - \end{bmatrix}$ $\begin{bmatrix} q & - \\ - & q \end{bmatrix}$ $\begin{bmatrix} - & q \\ - & q \end{bmatrix}$ $\begin{bmatrix} - & - \\ q & q \end{bmatrix}$

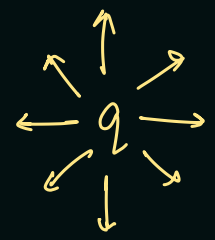
options ⇒ boxes.



N Queens Combinations - 2D as 1D - Queens Chooses:

we have nxn chess board, and n- identical queens, we have to place n-queen in nxn chessboard such that all queens should be safely placed.

move of queen in Chess



level → queen n = 4, box = nxn = 16 boxes.

options → boxes. queens = n = 4 queens.

Total possibly of placing 4 queens in 16 box = $^{16}C_4$

$$= \frac{16!}{12! \times 4!} = \frac{2\cancel{16} \times \cancel{15}^{5} \times 14 \times 13 \times \cancel{12!}}{\cancel{12!} \times \cancel{4} \times \cancel{3} \times \cancel{2} \times 1} = [1820]$$

Result

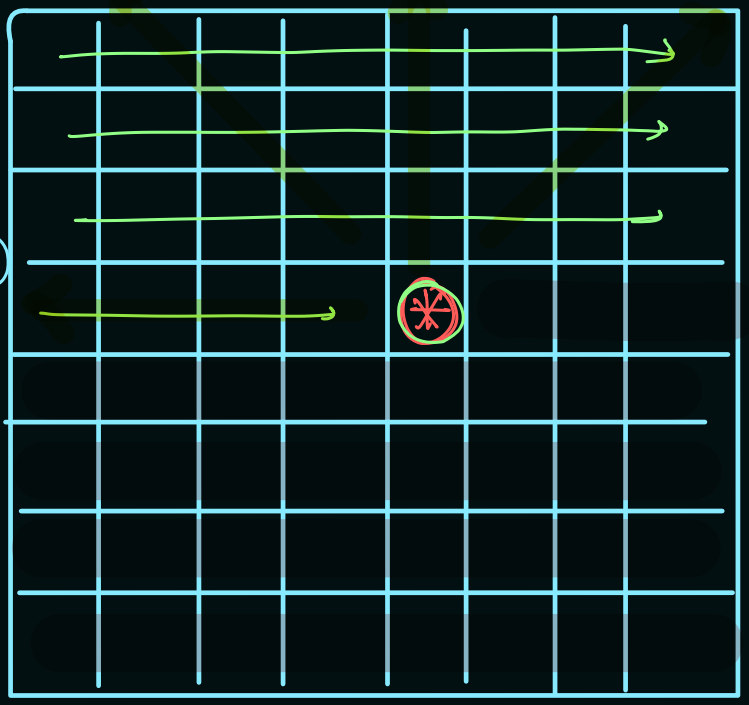
	0	1	2	3
0	-	q	-	-
1	-	-	-	q
2	q	-	-	-
3	-	-	q	-

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

	0	1	2	3
0			q	
1	q			
2				q
3		q		

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

How to check is position safe to place the queen?



Direction - ①

→ Row same
→ column from c-1 to 0

Direction - 2

→ Row decrement
→ Column decrement
] until both are valid.
(from r-1, c-1 to validity.

direction 3

→ Column same
→ Row decrement from r-1 to 0

direction 4:

→ Row decrement
→ Column Increment
] until both are valid
(r-1, c+1 to validity)

N Queen Permutation - 2D as 1D - Queen chooses ;

nxn → chess board
n → non-identical queens

no. of possible ways = ${}^{nxn}P_n$

3-box
2 queens
no. of way = ${}^{3}P_2 = \frac{3!}{1!} = 3 \times 2 = 6$

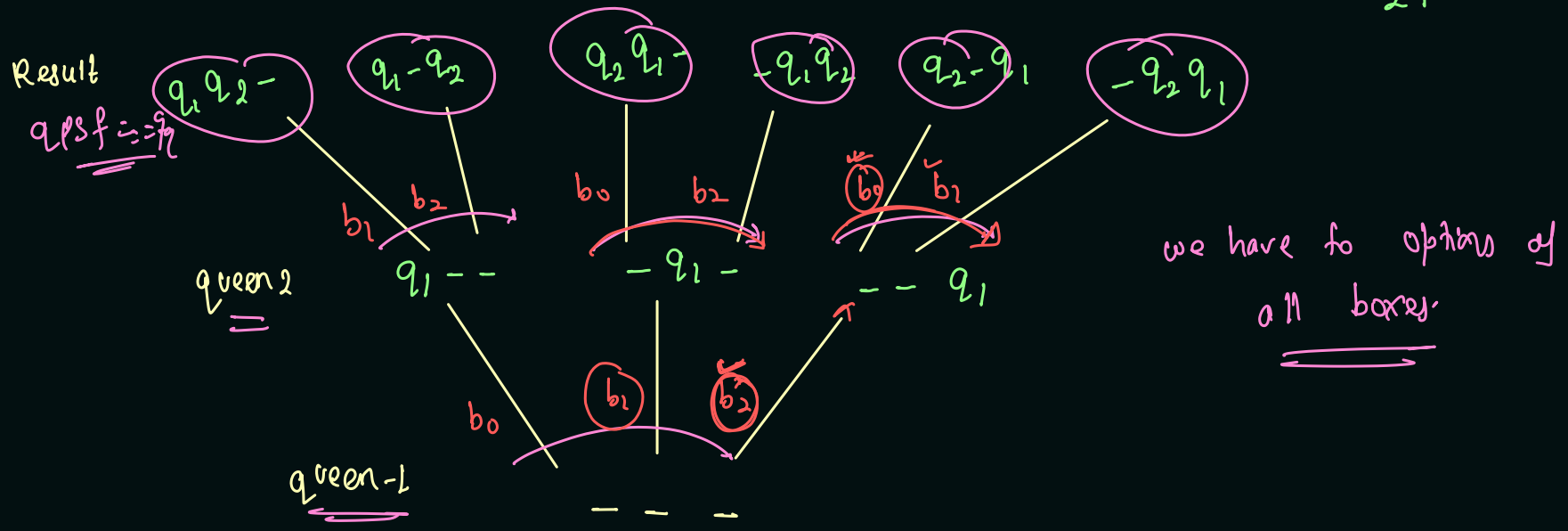
4x4 → 16 boxes
4 queens.
Total no. of ways = ${}^{16}P_4 = \frac{16 \times 15 \times 14 \times 13 \times 12!}{12!}$

$= 16 \times 15 \times 14 \times 13$

1 2 -
1 - 2
2 1 -
- 1 2
2 - 1
- 2 1

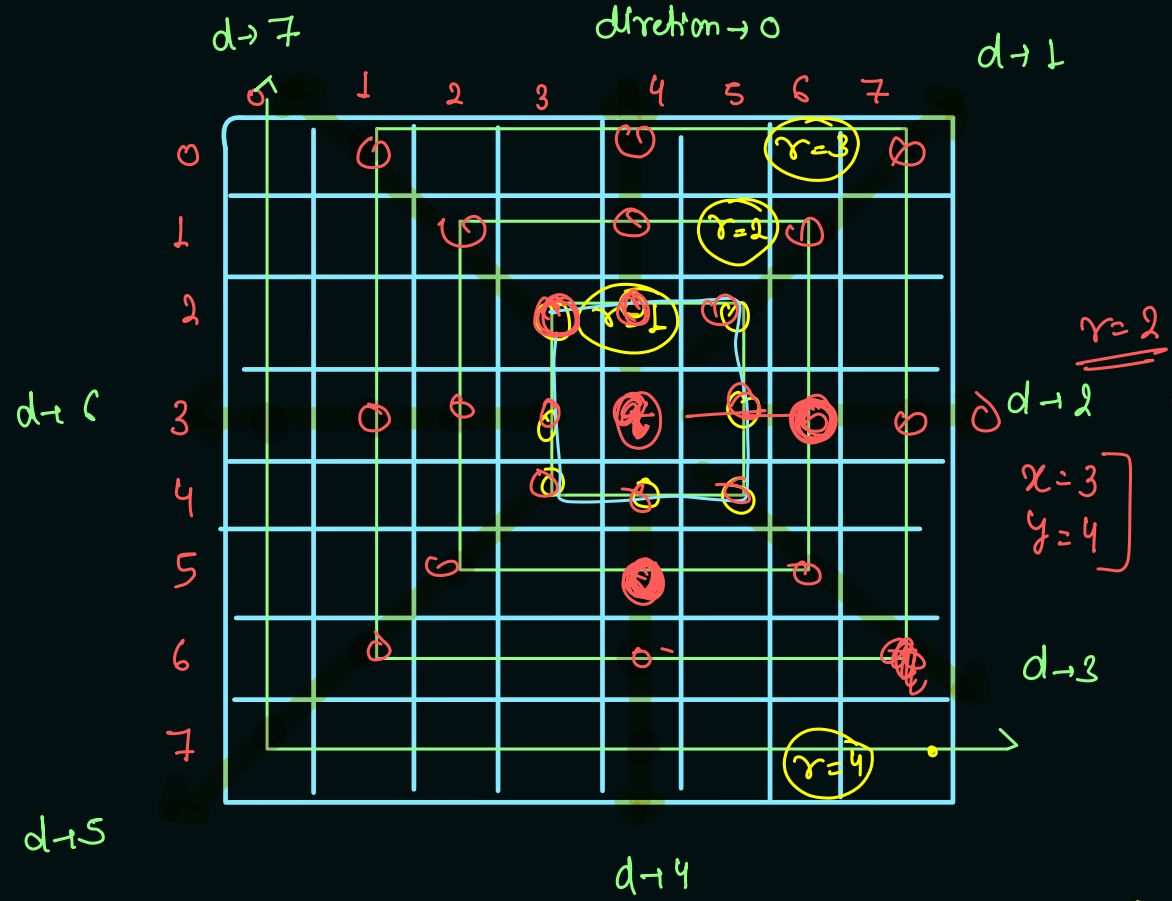
level → queen
options → boxes.

we Remove Invalid / unsafe option] =>



we have to options of all boxes.

How to check queen safety in case of permutation?:



Check in Radius:

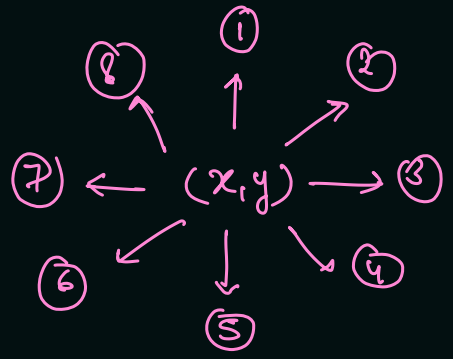
```
for(int rad=1 ; rad<n ; rad++) {
  for(int d=0 ; d<8 ; d++) {
    int r = x + (xdir[d] * rad);
    int c = y + (ydir[d] * rad);
    validity of r,c
  }
}
```

r = 3 + 1 * 2 = 3 + 2 = 5 (r=5)

c = 4 + 0 * 2 = 4 + 0 = 4 (c=4)

xdir → [-1, -1, 0, 1, 1, 1, 0, -1]
(0 1 2 3 4 5 6 7)

ydir → [0, 1, 1, 1, 0, -1, -1, -1]
(0 1 2 3 4 5 6 7)



① → (x-1, y)

② → (x-1, y+1)

③ → (x, y+1)

④ → (x+1, y+1)

⑤ → (x+1, y)

⑥ → (x+1, y-1)

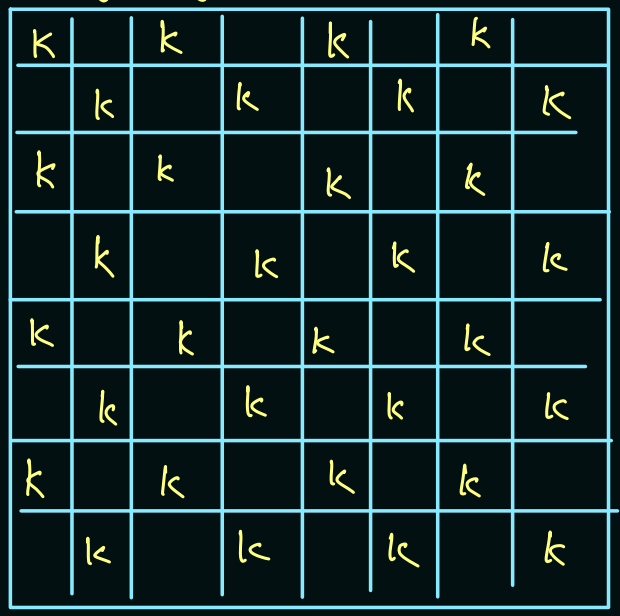
⑦ → (x, y-1)

⑧ → (x-1, y-1)

Interview tip:

Max. of knights place in chess board. ⟶

⟶ Every knight is safe.



Place knights in alternate diagonal of chess board.

N knights - Combination - 2D as 1D - knights Choose:

n x n - chess board, n - Identical knights

print all possible ways to arrange n knights safely.

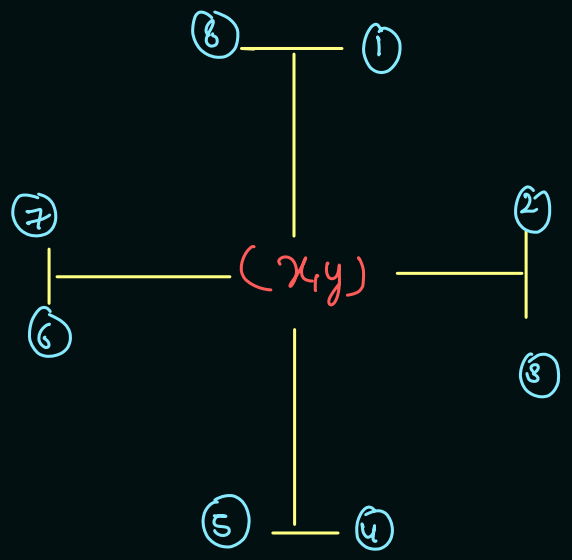
level → knight

option → box] → sorted order
solution
because of combination.

rdir → [-2, -1, 1, 2, 2, 1, -1, -2]

cdir - [1, 2, 2, 1, -1, -2, -2, -1]

Safety of knights



1. (x-2, y+1)
2. (x-1, y+2)
3. (x+1, y+2)
4. (x+2, y+1)
5. (x+2, y-1)
6. (x+1, y-2)
7. (x-1, y-2)
8. (x-2, y-1)