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Week - 4

=> Implement Hill climbing search algorithm to solve N-Queens problem

	1	2	3	4
1				Q
2		Q		
3			Q	
4	Q			

=> intial input board.
(row, col)
(1,4) (2,2) (3,3) (4,1)

Step 1: intial state

			Q
	Q		
		Q	
Q			

Attacking pairs
(2,2) <-> (3,3)
(1,4) <-> (4,1)
both diagonal
cost = 2

Step 2:

			Q
Q	Q		Q
		Q	
Q			

Attacking pairs:
~~(1,4) <-> (1,2)~~
(2,2) <-> (2,4)
(2,2) <-> (3,3)
(2,4) <-> (3,3)
cost = 3

Step 3:

		Q	
	Q		Q
Q			

A.P =>
(1,3) <-> (2,2)
(1,3) <-> (2,4)
(2,2) <-> (2,4)
cost = 3

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Step 4:

			Q
	Q	Q	
Q			

A.P =>
(2,4) <-> (3,3)
(3,2) <-> (4,1)
(3,2) <-> (3,3)
Cost = 3

Step 5:

	Q		
Q			Q
Q			
		Q	

A.P

no attacking pairs (no diagonal, no same row & column)

Algorithm

1. start with one queen in each column (intial board)
2. Calculate cost(h) = no of attacking queen pairs
3. for each column, move the queen to every other row & compute new cost
4. Choose the move that gives the lowest cost (best neighbor)
5. if best cost < cur cost, move queen there & repeat step 2.
6. if no neighbor has lowest cost, STOP.

O/P:

intial state (cost = 2):

			Q
	Q		
		Q	
Q			

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Step 1: Cost = 2

	Q		Q
		Q	
Q			

Step 2: Cost = 1

	Q		
			Q
		Q	
Q			

Step 3 (Cost = 1)

	Q		
			Q
Q		Q	

Step 4 (Cost = 0)

	Q		
			Q
Q			
		Q	

Soln found in 4 steps.

```
Initial State (cost=2):
. . . Q
. Q . .
. . Q .
Q . . .

Step 1 (cost=2):
. Q . Q
. . . .
. . Q .
Q . . .

Step 2 (cost=1):
. Q . .
. . . Q
. . Q .
Q . . .

Step 3 (cost=1):
. Q . .
. . . Q
. . . .
Q . Q .

Step 4 (cost=0):
. Q . .
. . . Q
Q . . .
. . Q .

Solution found in 4 steps ✅
```

Simulated Annealing

Algorithm:

```
current ← intial state
T ← a large +ve value
while T > 0 do
    next ← a random neighbour of current
    ΔE ← cur. cost - next. cost
    if ΔE > 0 then
        current ← next
    else
        current ← next with probability p = e^(ΔE/T)
    end if
    decrease T
end while
return current
```

Output:

The best position found is: [0 8 5 2 6 3 7 4]
The no of queens that are not attacking each other is : 8

```
The best position found is: [6, 3, 1, 7, 4, 2, 0, 5]
The number of queens that are not attacking each other is: 8
```