12/10/24 Week 5

Implement Simulated Annealing to solve N-Queens problem.

Algorithm:

1. Initialization:
   - Set the number of Queens N
   - Generate a random initial arrangement of queens (One Queen per column, randomly placed in rows)
   - Calculate the initiate cost.
   - Set the initial temperature T and cooling factor

2. While Stopping Criteria Not Met:
   - Make a Small Change: Randomly select a Queen and move it to different row in the same column to generate a new arrangement
   - Calculate New Cost: Compute the cost of the new arrangement.
   - Calculate Cost Difference: $\Delta cost$ = NewCost - CurrentCost.
   - Decision:
     - if $\Delta cost < 0$ (the new arrangement is better)
     - if $\Delta cost \geq 0$ (the new arrangement is worse)
       - Calculate acceptance probability: $P = e^{-T \Delta cost}$
       - Generate a random number r between 0 and 1

         if $r < p$:

         Accept the new arrangement.

         else:

         Reject the new arrangement and keep the current one.

3. Cool Down the Temperature:
   - Update the temperature using the cooling factor.
     $T = T \times cooling\_factor$

4. . Check stopping Criteria:
   You can stop if
   - You reach a maximum number of iterations.
   - ~~You~~ The temperature drops below a certain threshold.
   - You find a solution with zero cost (no attacks).

5. Output:
   Return the best arrangement and its cost.

State Space Tree:

0				Q
1		Q		
2	Q			
3			Q	

No of Queens : 4
Initial state = [2, 1, 3, 0]
Initial Temperature : 10.0
cooling factor : 0.95

Cost of initial state : 01 (2 attacks)

Generate a Neighbour: Move Queen 2 from row 1 to row 0

	Q		Q
Q			
	~~Q~~	Q	

New state : [2, 0, 3, 0]
cost : 01

=> Cost Difference : $\Delta cost = 2 - 2 = 0$

Since $\Delta cost = 0$, we calculate acceptance probability.
$P = e^{-T \Delta Cost} = e^{-10} = e$

Here r always less than e
So new state is accepted

$T = T \times 0.95 = 9.5$

Generate Neighbor:

Move Queen 4 from row 0 to row 1.

	Q		
			Q
Q			
		Q	

New state : [2, 0, 3, 1]

Cost = 0

Since the cost is 0, ~~we too~~ it meets the stopping Criteria.
Hence the new state is accepted and it is the final state.