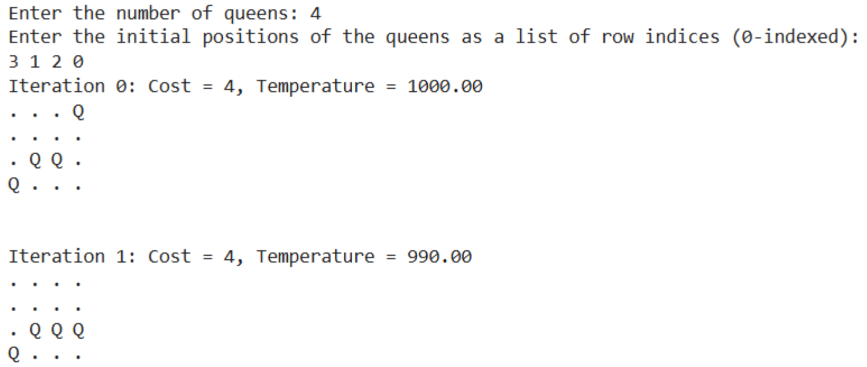
6.Implement Simulated Annealing to solve N-Queens problem.

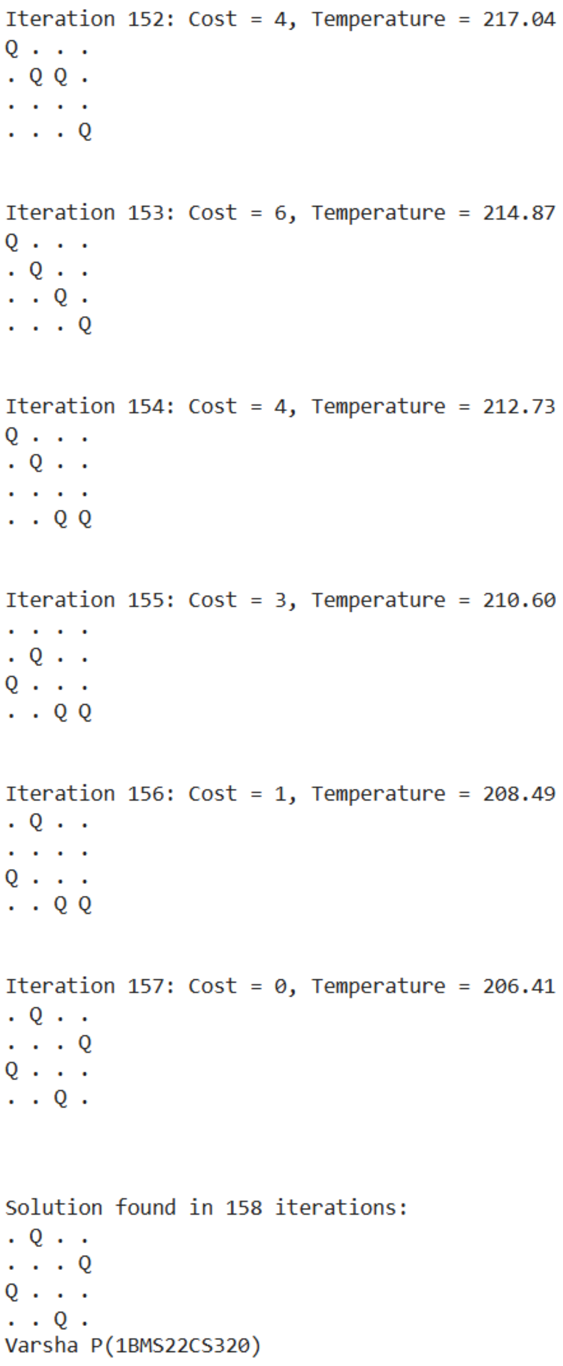
```
import random
import math



def calculate_conflicts(board):
    conflicts = 0
    n = len(board)
    for i in range(n):
        for j in range(i + 1, n):
            # Check if two queens are attacking each other
            if board[i] == board[j] or abs(board[i] - board[j]) == j - i:
                conflicts += 1
    return conflicts

# Function to simulate the annealing process
def simulated_annealing(board, max_iterations=10000, initial_temperature=1000,
cooling_rate=0.99):
    current_board = board[:]
    current_cost = calculate_conflicts(current_board)
    temperature = initial_temperature

    for iteration in range(max_iterations):
        if current_cost == 0:
            return current_board, iteration



        new_board = current_board[:]
        queen_index = random.randint(0, len(board) - 1)
        new_board[queen_index] = random.randint(0, len(board) - 1)

        new_cost = calculate_conflicts(new_board)



        if new_cost < current_cost or random.random() < math.exp((current_cost -
new_cost) / temperature):
            current_board = new_board
            current_cost = new_cost



        print(f"Iteration {iteration}: Cost = {current_cost}, Temperature =
{temperature:.2f}")
        print_board(current_board)
        print("\n")
        temperature *= cooling_rate

        if temperature < 1e-3:
            break

    return current_board, iteration


def print_board(board):
    n = len(board)
    for i in range(n):
        row = ['Q' if board[j] == i else '.' for j in range(n)]
        print(" ".join(row))


def main():
    n = int(input("Enter the number of queens: "))

    print("Enter the initial positions of the queens as a list of row indices (0-indexed):")
    board = list(map(int, input().split()))

    if len(board) != n:
        print("Error: The number of positions provided does not match the number of queens.")
        return

    solution, iterations = simulated_annealing(board)

    print(f"\nSolution found in {iterations} iterations:")
    print_board(solution)

main()

print("Varsha P(1BMS22CS320)")
```

Output:



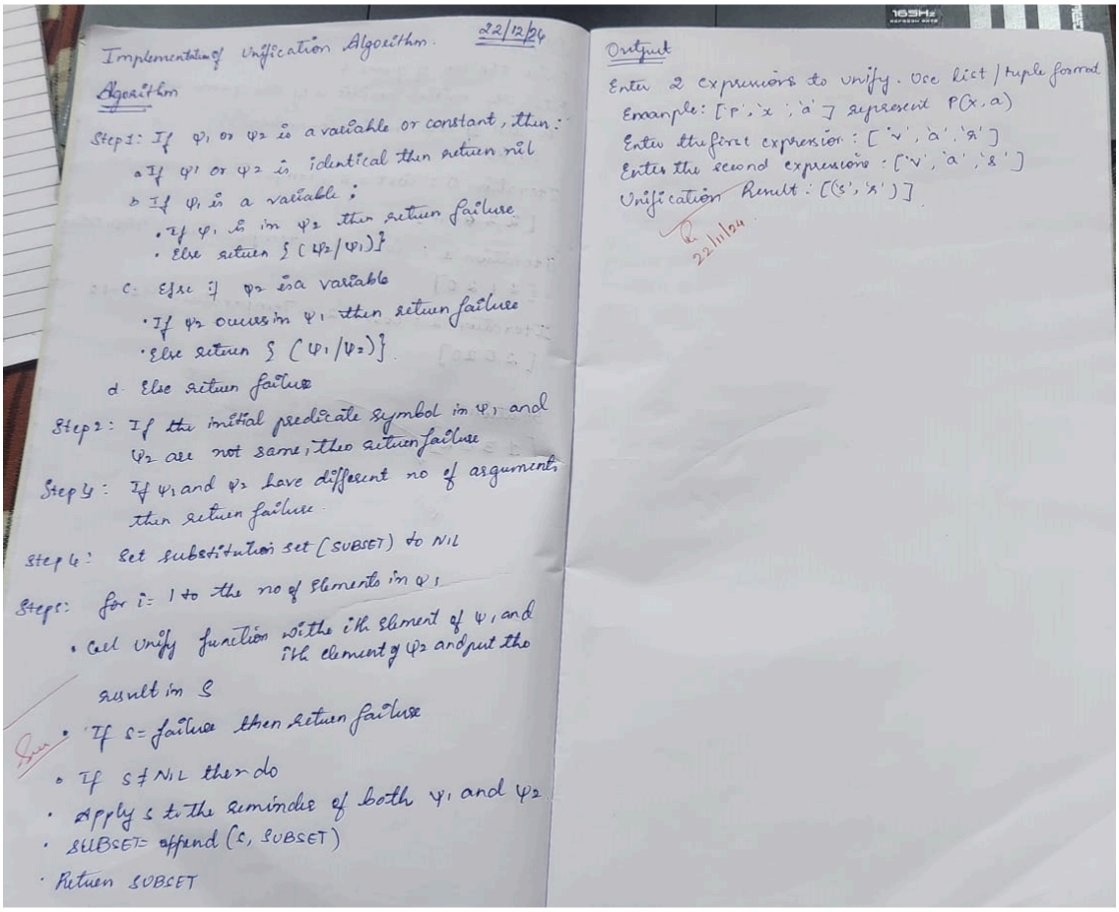
```
Enter the number of queens: 4
Enter the initial positions of the queens as a list of row indices (0-indexed):
3 1 2 0
Iteration 0: Cost = 4, Temperature = 1000.00
. . . Q
. . . .
. Q Q .
Q . . .


Iteration 1: Cost = 4, Temperature = 990.00
. . . .
. . . .
. Q Q Q
Q . . .
```

Last 5 Iterations:



```
Iteration 152: Cost = 4, Temperature = 217.04
Q . . .
. Q Q .
. . . .
. . . Q


Iteration 153: Cost = 6, Temperature = 214.87
Q . . .
. Q . .
. . Q .
. . . Q


Iteration 154: Cost = 4, Temperature = 212.73
Q . . .
. Q . .
. . . .
. . Q Q


Iteration 155: Cost = 3, Temperature = 210.60
. . . .
. Q . .
Q . . .
. . Q Q


Iteration 156: Cost = 1, Temperature = 208.49
. Q . .
. . . .
Q . . .
. . Q Q


Iteration 157: Cost = 0, Temperature = 206.41
. Q . .
. . . Q
Q . . .
. . Q .



Solution found in 158 iterations:
. Q . .
. . . Q
Q . . .
. . Q .
Varsha P(1BMS22CS320)
```

Observation



Implementation of Unification Algorithm. 22/12/24

Algorithm

```
Step 1: If $\psi_1$ or $\psi_2$ is a variable or constant, then:
    a. If $\psi_1$ or $\psi_2$ is identical then return nil
    b. If $\psi_1$ is a variable:
        • If $\psi_1$ is in $\psi_2$ then return failure
        • Else return $\{(\psi_2/\psi_1)\}$
    c. Else if $\psi_2$ is a variable
        • If $\psi_2$ occurs in $\psi_1$ then return failure
        • Else return $\{(\psi_1/\psi_2)\}$
    d. Else return failure
Step 2: If the initial predicate symbol in $\psi_1$ and
        $\psi_2$ are not same, then return failure
Step 4: If $\psi_1$ and $\psi_2$ have different no of arguments
        then return failure
Step 4: Set substitution set (SUBSET) to NIL
Step 5: for i = 1 to the no of elements in $\psi_1$
    • Call unify function with the ith element of $\psi_1$ and
      ith element of $\psi_2$ and put the result in S
    • If S = failure then return failure
    • If S ≠ NIL then do
    • Apply S to the remainder of both $\psi_1$ and $\psi_2$
    • SUBSET = append (S, SUBSET)
    • Return SUBSET
```

Output

```
Enter 2 expressions to unify. Use list / tuple format
Example: ['P', 'x', 'a'] represent P(x, a)
Enter the first expression: ['v', 'a', 'x']
Enter the second expressions: ['v', 'a', 's']
Unification Result: [('s', 'x')]
```

22/11/24