

```

def print_solution(queens, N):
    for i in range(N):
        row = ""
        for j in range(N):
            if queens[i] == j:
                row += 'Q '
            else:
                row += '. '
        print(row)
    print("\n")

def is_safe(queens, row, col):
    for i in range(row):
        if queens[i] == col or abs(queens[i] - col) == row - i:
            return False
    return True

def solve_nqueens(N):
    queens = [-1] * N
    solutions = []
    row = 0
    col = 0
    while row >= 0:
        while col < N:
            if is_safe(queens, row, col):
                queens[row] = col
                if row == N - 1:
                    solutions.append(queens[:])
                    col = N
                else:
                    row += 1
                    col = 0
                    break
            else:
                col += 1
        else:
            row -= 1
            if row >= 0:
                col = queens[row] + 1
    return solutions

def show_solutions_for_nqueens(N):
    solutions = solve_nqueens(N)
    print(f"Solutions for {N}-Queens problem:")
    for sol in solutions:
        print_solution(sol, N)
show_solutions_for_nqueens(4)

```

^ Solutions for 4-Queens problem:

```

. Q . .
. . . Q
Q . . .
. . Q .

. . Q .
Q . . .
. . . Q
. Q . .

```

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<pre> def print_board(queens, N, M): for i in range(N): row = "" for j in range(M): if queens[i] == j: row += 'Q ' else: row += '. ' print(row) print("\n") def is_safe(queens, row, col, N, M): for i in range(row): if queens[i] == col or abs(queens[i] - col) == row - i: return False return True def solve_nqueens(N, M): queens = [-1] * N solutions = [] row = 0 col = 0 while row >= 0: while col < M: if is_safe(queens, row, col, N, M): queens[row] = col if row == N - 1: solutions.append(queens[:]) col = M else: row += 1 col = 0 break else: col += 1 else: row -= 1 if row >= 0: col = queens[row] + 1 return solutions solutions = solve_nqueens(8, 10) print("Solutions for 8x10 board:") for sol in solutions: print_board(sol, 8, 10) </pre>	<p>Solutions for 8x10 board:</p> <pre> Q Q Q . Q . . . Q Q Q Q Q Q Q Q Q Q Q Q </pre>
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Output

```
1 def print_board(board):
2     for row in board:
3         print(" ".join(row))
4     print("\n")
5 def is_valid(board, row, col, num):
6     for i in range(9):
7         if board[row][i] == num:
8             return False
9     for i in range(9):
10        if board[i][col] == num:
11            return False
12    start_row = (row // 3) * 3
13    start_col = (col // 3) * 3
14    for i in range(3):
15        for j in range(3):
16            if board[start_row + i][start_col + j] == num:
17                return False
18    return True
19 def solve_sudoku(board):
20     for row in range(9):
21         for col in range(9):
22             if board[row][col] == '.':
23                 for num in '123456789':
24                     if is_valid(board, row, col, num):
25                         board[row][col] = num
26                         if solve_sudoku(board):
27                             return True
28                         board[row][col] = '.'
29     return False
30 return True
31 board = [
32     ["5", "3", ".", ".", "7", ".", ".", ".", "."],
33     ["6", ".", ".", "1", "9", "5", ".", ".", "."],
34     [".", "9", "8", ".", ".", ".", "6", ".", "."],
35     ["8", ".", ".", "6", ".", ".", ".", "3", "."],
36     ["4", ".", ".", "8", ".", "3", ".", ".", "1"],
37     ["7", ".", ".", "2", ".", ".", ".", "6", "."],
38     [".", "6", ".", ".", ".", "2", "8", ".", "."],
39     [".", ".", "4", "1", "9", ".", ".", "5"],
40     [".", ".", "8", ".", "8", ".", "7", "9"]
41 ]
42 solve_sudoku(board)
43 print("Solved Sudoku:")
44 print_board(board)
45
```

```
Solved Sudoku:
5 3 4 6 7 8 9 1 2
6 7 2 1 9 5 3 4 8
1 9 8 3 4 2 5 6 7
8 5 9 7 6 1 4 2 3
4 2 6 8 5 3 7 9 1
7 1 3 9 2 4 8 5 6
9 6 1 5 3 7 2 8 4
2 8 7 4 1 9 6 3 5
3 4 5 2 8 6 1 7 9
```

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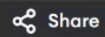
Output

```
1- def print_board(board):
2-     for row in board:
3-         print(" ".join(row))
4-     print("\n")
5- def is_valid(board, row, col, num):
6-     for i in range(9):
7-         if board[row][i] == num:
8-             return False
9-     for i in range(9):
10-        if board[i][col] == num:
11-            return False
12-     start_row = (row // 3) * 3
13-     start_col = (col // 3) * 3
14-     for i in range(3):
15-         for j in range(3):
16-             if board[start_row + i][start_col + j] == num:
17-                 return False
18-     return True
19- def solve_sudoku(board):
20-     for row in range(9):
21-         for col in range(9):
22-             if board[row][col] == '.':
23-                 for num in '123456789':
24-                     if is_valid(board, row, col, num):
25-                         board[row][col] = num
26-                         if solve_sudoku(board):
27-                             return True
28-                         board[row][col] = '.'
29-                 return False
30-     return True
31- board = [
32-     ["5", "3", ".", ".", "7", ".", ".", ".", "."],
33-     ["6", ".", ".", "1", "9", "5", ".", ".", "."],
34-     [".", "9", "8", ".", ".", ".", "6", "."],
35-     ["8", ".", ".", "6", ".", ".", "3", "."],
36-     ["4", ".", ".", "8", ".", "3", ".", ".", "1"],
37-     ["7", ".", ".", "2", ".", ".", "6", "."],
38-     [".", "6", ".", ".", "2", "8", ".", "."],
39-     [".", ".", ".", "4", "1", "9", ".", ".", "5"],
40-     [".", ".", ".", "8", ".", ".", "7", "9"]
41- ]
42- solve_sudoku(board)
43- print("Solved Sudoku:")
44- print_board(board)
```

```
Solved Sudoku:
5 3 4 6 7 8 9 1 2
6 7 2 1 9 5 3 4 8
1 9 8 3 4 2 5 6 7
8 5 9 7 6 1 4 2 3
4 2 6 8 5 3 7 9 1
7 1 3 9 2 4 8 5 6
9 6 1 5 3 7 2 8 4
2 8 7 4 1 9 6 3 5
3 4 5 2 8 6 1 7 9
```

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```
1 def count_ways(nums, index, current_sum, target):
2     if index == len(nums):
3         if current_sum == target:
4             return 1
5         else:
6             return 0
7     add = count_ways(nums, index + 1, current_sum + nums[index], target)
8     subtract = count_ways(nums, index + 1, current_sum - nums[index], target)
9     return add + subtract
10 def find_target_sum_ways(nums, target):
11     return count_ways(nums, 0, 0, target)
12 nums = [1, 1, 1, 1, 1]
13 target = 3
14 result = find_target_sum_ways(nums, target)
15 print("Number of ways to reach target:", result)
16
```

Number of ways to reach target: 5
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```
1 def find_combinations(candidates, target):
2     result = []
3     combination = []
4     def backtrack(start, remaining_target):
5         if remaining_target == 0:
6             result.append(combination[:])
7             return
8         for i in range(start, len(candidates)):
9             if i > start and candidates[i] == candidates[i-1]:
10                 continue
11             candidate = candidates[i]
12             if candidate > remaining_target:
13                 continue
14             combination.append(candidate)
15             backtrack(i + 1, remaining_target - candidate)
16             combination.pop()
17     candidates.sort()
18     backtrack(0, target)
19     return result
20 candidates = [10, 1, 2, 7, 6, 1, 5]
21 target = 8
22 result = find_combinations(candidates, target)
23 print("Unique combinations that sum to target:", result)
```

Unique combinations that sum to target: [[1, 1, 6], [1, 2, 5], [1, 7], [2, 6]]

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```
1 MOD = 10**9 + 7
2 def sum_of_subarray_mins(arr):
3     n = len(arr)
4     left = [0] * n
5     right = [0] * n
6     stack = []
7     for i in range(n):
8         count = 1
9         while stack and arr[stack[-1]] > arr[i]:
10             count += left[stack.pop()]
11         left[i] = count
12         stack.append(i)
13     stack = []
14     for i in range(n-1, -1, -1):
15         count = 1
16         while stack and arr[stack[-1]] >= arr[i]:
17             count += right[stack.pop()]
18         right[i] = count
19         stack.append(i)
20     result = 0
21     for i in range(n):
22         result = (result + arr[i] * left[i] * right[i]) % MOD
23     return result
24 arr = [3, 1, 2, 4]
25 result = sum_of_subarray_mins(arr)
26 print("Sum of subarray minimums:", result)
27
```

Sum of subarray minimums: 17

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Output

```
1 def find_permutations(nums):
2     result = []
3     permutation = []
4     n = len(nums)
5     used = [False] * n
6     def backtrack():
7         if len(permutation) == n:
8             result.append(permutation[:])
9             return
10        for i in range(n):
11            if not used[i]:
12                used[i] = True
13                permutation.append(nums[i])
14                backtrack()
15                permutation.pop()
16                used[i] = False
17        backtrack()
18    return result
19 nums = [1, 2, 3]
20 result = find_permutations(nums)
21 print("All permutations:", result)
22
```

All permutations: [[1, 2, 3], [1, 3, 2], [2, 1, 3], [2, 3, 1], [3, 1, 2], [3, 2, 1]]

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```
1 def find_unique_permutations(nums):
2     result = []
3     permutation = []
4     n = len(nums)
5     used = [False] * n
6     def backtrack():
7         if len(permutation) == n:
8             result.append(permutation[:])
9             return
10        for i in range(n):
11            if used[i] or (i > 0 and nums[i] == nums[i-1] and not used[i-1]):
12                continue
13            used[i] = True
14            permutation.append(nums[i])
15            backtrack()
16            permutation.pop()
17            used[i] = False
18    nums.sort()
19    backtrack()
20    return result
21    nums = [1, 1, 2]
22    result = find_unique_permutations(nums)
23    print("Unique permutations:", result)
24
```

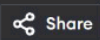
Output

Clean

All permutations: [[1, 2, 3], [1, 3, 2], [2, 1, 3], [2, 3, 1], [3, 1, 2], [3, 2, 1]]

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Run

Output

```
1 def find_combinations(candidates, target):
2     result = []
3     combination = []
4     def backtrack(start, remaining_target):
5         if remaining_target == 0:
6             result.append(combination[:])
7             return
8         for i in range(start, len(candidates)):
9             candidate = candidates[i]
10            if candidate > remaining_target:
11                continue
12            combination.append(candidate)
13            backtrack(i, remaining_target - candidate)
14            combination.pop()
15    backtrack(0, target)
16    return result
17 candidates = [2, 3, 6, 7]
18 target = 7
19 result = find_combinations(candidates, target)
20 print("Combinations that sum to target:", result)
21
```

Combinations that sum to target: [[2, 2, 3], [7]]

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