Recursion Problems in C++

1. Expression Evaluation with Parentheses

Write a recursive function that evaluates a mathematical expression containing numbers, +, -, *, /, and nested parentheses. For example, given the input "3+(6*2)-(5/(2+3))", the function should return the result.

2. Generate All Valid Braces Combinations

Design a recursive function that generates all valid combinations of N pairs of braces {}. For instance, for N=2, it should generate: {{}} and {}.

3. Optimal Move in a Game Board

Implement a recursive solution for a grid game where you start at (0, 0) of an MxN grid and must maximize your score by reaching (M-1, N-1). Each cell has a score, and you can only move right or down. Add support for a variable number of backtracking steps.

4. Sudoku Solver

Implement a recursive backtracking algorithm to solve a Sudoku puzzle. The puzzle is provided as a 9x9 grid with some cells pre-filled. Your function should return the solved grid.

5. N-Queens Problem - Count All Arrangements

Write a function that recursively solves the N-Queens problem and returns the number of all possible arrangements rather than just one solution. Generalize the implementation for boards of size NxN.

6. Word Break Problem

Given a string s and a dictionary of valid words dict, write a recursive function to determine if the string can be segmented into valid words. Additionally, print all possible segmentations.

7. Tiling Problem

You have a 2xN board and tiles of size 2x1 and 2x2. Write a recursive function to determine the number of ways to tile the board.

8. Sum of All Root-to-Leaf Paths

Given a binary tree with integers as node values, write a recursive function to compute the sum of all numbers formed by paths from the root to leaves. For example, for the path 1->2->3, the number formed is 123.

9. Permutation of Subsets with Conditions

Write a recursive function to generate all permutations of size r (subset size) from a given array, but include only those where the sum of the subset's elements is greater than k (user-defined). Ensure that subsets do not repeat.

10. Crossword Puzzle Solver

Given a NxN crossword grid, with some cells marked as empty or blocked, and a list of words, write a recursive function to fill the grid with the words. The words can be placed horizontally or vertically. Return all possible valid configurations.