Problem of the Week – The 24 Game

Company: Twitter | PayPal (Coding Variant)
Difficulty: Hard
Topic: Recursion, Backtracking, Expression Evaluation

Scenario

The **24 Game** is a popular math puzzle. You're given **four integers (1–9)** in a fixed order, and you must determine if it's possible to reach **exactly 24** by inserting the operators `+`, `-`, `*`, `/` and grouping with parentheses.

This tests not only your problem-solving but also your **recursion & backtracking** skills.

Problem Statement

Given a list of 4 integers, determine whether it is possible to reach the value **24** by applying arithmetic operations (`+`, `-`, `*`, `/`) and parentheses in any valid arrangement.

Return `true` if possible, otherwise `false`.

Input Format

- Four space-separated integers `a1 a2 a3 a4` (each between 1 and 9).

Output Format

- Print `true` if 24 can be formed, else `false`.

Examples

Sample Input 0

```
5 2 7 8
```

Sample Output 0

```
true
```

Explanation 0
(5 × 2 - 7) × 8 = 24

Sample Input 1

```
1 1 1 1
```

Sample Output 1

```
false
```

Explanation 1
No combination of operations can produce 24.

Approaches

1. **Brute Force Enumeration**
    - Try all permutations of numbers.
    - Try all operator combinations.
    - Try all parenthesization orders.
    - Time complexity: large but feasible since N=4.
2. **Recursion & Backtracking (Efficient)**
    - Treat it as a **search problem**.
    - At each step, pick two numbers, apply an operation, and recurse with the reduced list.
    - Base case: when only one number remains, check if it is 24 (within floating-point tolerance).

🔗 Practice Links

- LeetCode 679 – 24 Game
- GeeksforGeeks – The 24 Game Problem