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**Water Jug Problem**

## Introduction

The Water Jug Problem is a well-known puzzle in artificial intelligence that requires measuring an exact amount of water using two jugs of different capacities. In this project, we solve the problem using the **Depth-First Search (DFS)** algorithm.

## Problem Description

We are given two jugs with the following capacities:

* **Jug 1 Capacity:** 4 liters
* **Jug 2 Capacity:** 3 liters

The goal is to measure exactly **2 liters** of water using these jugs by performing a series of valid operations.

## Allowed Operations

The following operations can be performed on the jugs:

1. Fill **Jug 1** completely.
2. Fill **Jug 2** completely.
3. Empty **Jug 1**.
4. Empty **Jug 2**.
5. Pour water from **Jug 1** into **Jug 2** until Jug 2 is full or Jug 1 is empty.
6. Pour water from **Jug 2** into **Jug 1** until Jug 1 is full or Jug 2 is empty.

## Approach

To find a solution, we use the **Depth-First Search (DFS)** algorithm, which explores possible states of the jugs by performing the allowed operations. A **stack** is used to keep track of explored states, while a **set** prevents revisiting the same state. Additionally, a **dictionary** helps reconstruct the sequence of steps leading to the solution.

## Explanation

* get\_successors(state, capacities): Generates possible next states by applying the allowed operations.
* dfs(capacities, target): Implements the DFS algorithm, exploring different possibilities to reach the target measurement.
* **Execution**: The algorithm starts with both jugs empty and explores different configurations until the exact 2-liter measurement is achieved.

## Expected Output

If a solution exists, the program prints the sequence of steps to achieve the target. If no solution is possible, it prints a message stating that no valid sequence was found.

## Conclusion

This project demonstrates the effectiveness of **Depth-First Search (DFS)** in solving the Water Jug Problem. By systematically exploring possible states, we successfully determine a valid sequence of operations to measure the required amount of water. This approach showcases how AI search algorithms can be applied to real-world problem-solving scenarios.

**Output:**

