1. Write a python program to solve the Water Jug problem: you are given 2 jugs, a 4-gallon one and 3-gallon one. Neither has any measuring maker on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 gallons of water into 4-gallon jug? Explicit assumptions: A jug can be filled from the pump, water can be poured out of a jug onto the ground, water can be poured from one jug to another and that there are no other measuring devices available.

Program :

```
from queue import Queue


def water_jug_problem():
    # Initial state: both jugs are empty
    initial_state = (0, 0)

    # Queue to store states and steps
    queue = Queue()
    queue.put((initial_state, []))

    # Visited states set to avoid loops
    visited = set()

    while not queue.empty():
        current_state, steps = queue.get()

        if current_state[0] == 2:
            # Found a solution
```

```
            print("Solution found in {} steps:".format(len(steps)))
            for step in steps:
                print(step)
            return

        visited.add(current_state)

        # Possible operations
        operations = [
            ("Fill 4-gallon jug", (4, current_state[1])),
            ("Fill 3-gallon jug", (current_state[0], 3)),
            ("Empty 4-gallon jug", (0, current_state[1])),
            ("Empty 3-gallon jug", (current_state[0], 0)),
            ("Pour water from 3-gallon jug to 4-gallon jug", (min(4, current_state[0] + current_state[1]), max(0, current_state[0] + current_state[1] - 4))),
            ("Pour water from 4-gallon jug to 3-gallon jug", (max(0, current_state[0] + current_state[1] - 3), min(3, current_state[0] + current_state[1])))
        ]

        for operation, next_state in operations:
            if next_state not in visited:
                queue.put((next_state, steps + [operation]))

    print("No solution found.")
```

```
# Solve the water jug problem

water_jug_problem()
```

Output :

```
Solution found in 6 steps:
Fill 4-gallon jug
Pour water from 4-gallon jug to 3-gallon jug
Empty 3-gallon jug
Pour water from 4-gallon jug to 3-gallon jug
Fill 4-gallon jug
Pour water from 4-gallon jug to 3-gallon jug
```