AI PRACTICAL NO. 3

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Div:TE COMPS A (BATCH B)

PART 1 :

```
def pour_water(state, action):
    x, y = state
    if action == 'fill_4':
        return (4, y)
    elif action == 'fill_3':
        return (x, 3)
    elif action == 'empty_4':
        return (0, y)
    elif action == 'empty_3':
        return (x, 0)
    elif action == 'pour_4_to_3':
        amount = min(x, 3 - y)
        return (x - amount, y + amount)
    elif action == 'pour_3_to_4':
        amount = min(y, 4 - x)
        return (x + amount, y - amount)
    else:
        return state

def dfs(state, visited):
    if state[0] == 2:
        return [state]
    visited.add(state)
    for action in ['fill_4', 'fill_3', 'empty_4', 'empty_3', 'pour_4_to_3',
'pour_3_to_4']:
        new_state = pour_water(state, action)
        if new_state not in visited:
            path = dfs(new_state, visited)
            if path:
                return [state] + path
    return None

def print_steps(path):
    for i, state in enumerate(path):
        jug_4, jug_3 = state
        if i == 0:
            print(f"Initial State: {jug_4} | {jug_3}")
        else:
```

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            prev_jug_4, prev_jug_3 = path[i - 1]
            if jug_4 > prev_jug_4:
                print(f"Fill Jug1: {jug_4} | {jug_3}")
            elif jug_3 > prev_jug_3:
                print(f"Fill Jug2: {jug_4} | {jug_3}")
            elif jug_4 < prev_jug_4:
                print(f"Empty Jug1: {jug_4} | {jug_3}")
            elif jug_3 < prev_jug_3:
                print(f"Empty Jug2: {jug_4} | {jug_3}")
            elif jug_4 != prev_jug_4 and jug_3 != prev_jug_3:
                if jug_4 == 0:
                    print(f"Pour Jug2 to Jug1: {jug_4} | {jug_3}")
                elif jug_3 == 0:
                    print(f"Pour Jug1 to Jug2: {jug_4} | {jug_3}")

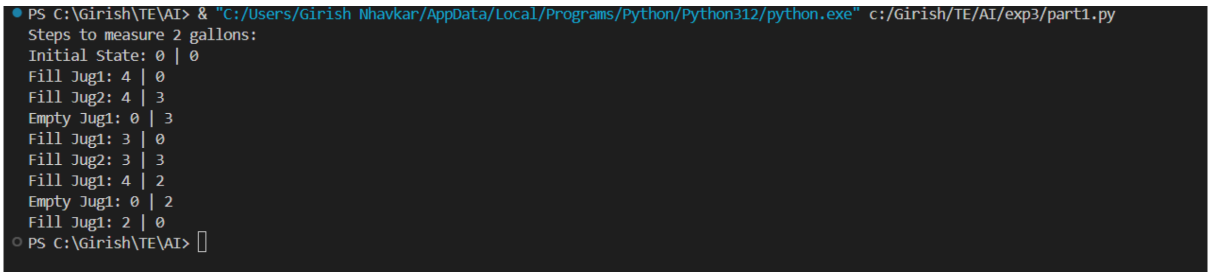
initial_state = (0, 0)
visited = set()
path = dfs(initial_state, visited)

if path:
    print("Steps to measure 2 gallons:")
    print_steps(path)
else:
    print("No solution found.")


#output of the code

# Steps to measure 2 gallons:
# Initial State: 0 | 0
# Fill Jug1: 4 | 0
# Fill Jug2: 4 | 3
# Empty Jug1: 0 | 3
# Fill Jug1: 3 | 0
# Fill Jug2: 3 | 3
# Fill Jug1: 4 | 2
# Empty Jug1: 0 | 2
# Fill Jug1: 2 | 0
```

OUTPUT:



```
● PS C:\Girish\TE\AI> & "C:/Users/Girish Nhavkar/AppData/Local/Programs/Python/Python312/python.exe" c:/Girish/TE/AI/exp3/part1.py
  Steps to measure 2 gallons:
  Initial State: 0 | 0
  Fill Jug1: 4 | 0
  Fill Jug2: 4 | 3
  Empty Jug1: 0 | 3
  Fill Jug1: 3 | 0
  Fill Jug2: 3 | 3
  Fill Jug1: 4 | 2
  Empty Jug1: 0 | 2
  Fill Jug1: 2 | 0
○ PS C:\Girish\TE\AI> 
```

PART 2:

```
class State:
    def __init__(self, missionaries, cannibals, boat_position):
        self.missionaries = missionaries
        self.cannibals = cannibals
        self.boat_position = boat_position

    def is_valid(self):
        if (
            0 <= self.missionaries <= 3
            and 0 <= self.cannibals <= 3
            and 0 <= self.boat_position <= 1
        ):
            if (
                self.missionaries == 0
                or self.missionaries == 3
                or self.missionaries >= self.cannibals
            ):
                return True
        return False

    def is_goal(self):
        return self.missionaries == 0 and self.cannibals == 0 and
self.boat_position == 0

    def __eq__(self, other):
        return (
            self.missionaries == other.missionaries
            and self.cannibals == other.cannibals
            and self.boat_position == other.boat_position
        )

    def __hash__(self):
        return hash((self.missionaries, self.cannibals, self.boat_position))


def generate_next_states(current_state):
    next_states = []
    moves = [(1, 0), (2, 0), (0, 1), (0, 2), (1, 1)]

    for m, c in moves:
        if current_state.boat_position == 1:
            new_state = State(
                current_state.missionaries - m,
                current_state.cannibals - c,
                0,
```

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            )
        else:
            new_state = State(
                current_state.missionaries + m,
                current_state.cannibals + c,
                1,
            )

        if new_state.is_valid():
            next_states.append(new_state)

    return next_states


def dfs_search():
    start_state = State(3, 3, 1)
    goal_state = State(0, 0, 0)

    stack = [(start_state, [])]
    visited = set()

    while stack:
        current_state, path = stack.pop()

        if current_state.is_goal():
            return path

        if current_state not in visited:
            visited.add(current_state)

            next_states = generate_next_states(current_state)
            for next_state in next_states:
                if next_state not in visited:
                    stack.append((next_state, path + [current_state]))

    return None


def print_state_description(state):
    left_shore = f"{state.missionaries} Missionaries and {state.cannibals}
Cannibals on the Left Shore"
    right_shore = f"{3 - state.missionaries} Missionaries and {3 -
state.cannibals} Cannibals on the Right Shore"

    print(f"{left_shore}, {right_shore}\n")



if __name__ == "__main__":
    solution_path = dfs_search()

    if solution_path:
        print("Solution Path:")
        for i, state in enumerate(solution_path):
            print(f"Step {i + 1}:")
            print_state_description(state)

    else:
        print("No solution found.")

#output of code

# Solution Path:
# Step 1:
# 3 Missionaries and 3 Cannibals on the Left Shore, 0 Missionaries and 0
Cannibals on the Right Shore

# Step 2:
# 2 Missionaries and 2 Cannibals on the Left Shore, 1 Missionaries and 1
Cannibals on the Right Shore

# Step 3:
# 3 Missionaries and 2 Cannibals on the Left Shore, 0 Missionaries and 1
Cannibals on the Right Shore

# Step 4:
# 2 Missionaries and 1 Cannibals on the Left Shore, 1 Missionaries and 2
Cannibals on the Right Shore

# Step 5:
# 2 Missionaries and 2 Cannibals on the Left Shore, 1 Missionaries and 1
Cannibals on the Right Shore

# Step 6:
# 1 Missionaries and 1 Cannibals on the Left Shore, 2 Missionaries and 2
Cannibals on the Right Shore

# Step 7:
# 3 Missionaries and 1 Cannibals on the Left Shore, 0 Missionaries and 2
Cannibals on the Right Shore

# Step 8:
# 2 Missionaries and 0 Cannibals on the Left Shore, 1 Missionaries and 3
Cannibals on the Right Shore

# Step 9:
```
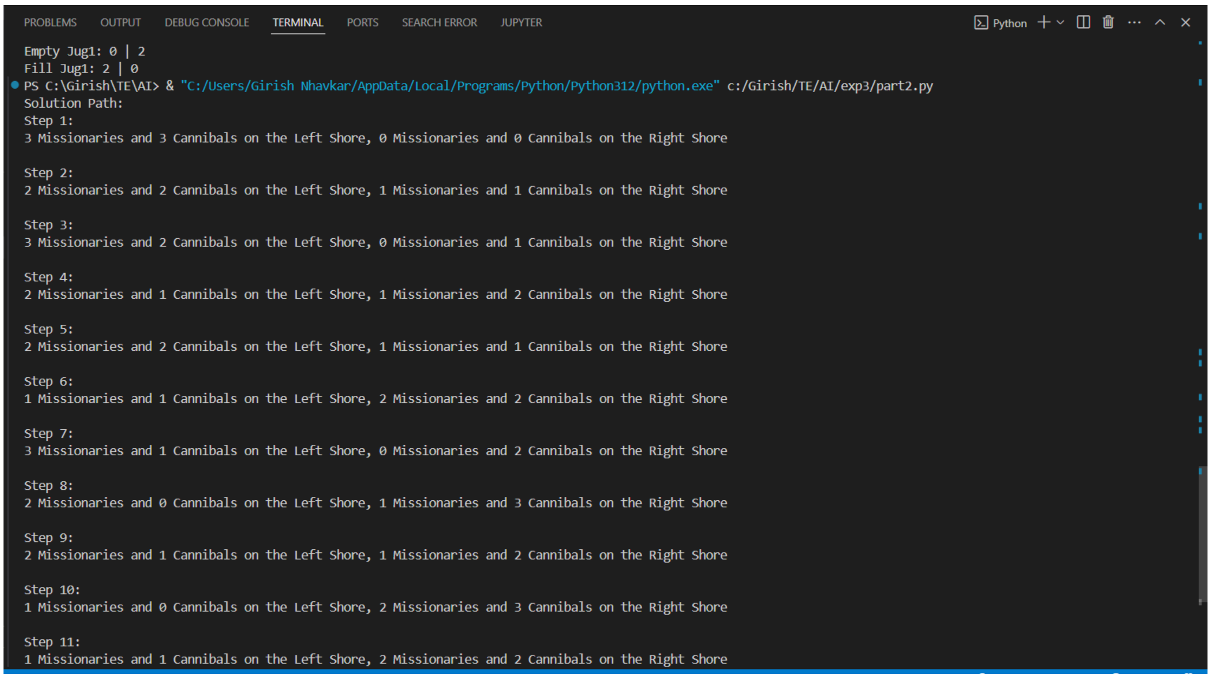

```
# 2 Missionaries and 1 Cannibals on the Left Shore, 1 Missionaries and 2
Cannibals on the Right Shore

# Step 10:
# 1 Missionaries and 0 Cannibals on the Left Shore, 2 Missionaries and 3
Cannibals on the Right Shore

# Step 11:
# 1 Missionaries and 1 Cannibals on the Left Shore, 2 Missionaries and 2
Cannibals on the Right Shore
```

OUTPUT :



```
Empty Jug1: 0 | 2
Fill Jug1: 2 | 0
PS C:\Girish\TE\AI> & "C:/Users/Girish Nhavkar/AppData/Local/Programs/Python/Python312/python.exe" c:/Girish/TE/AI/exp3/part2.py
Solution Path:
Step 1:
3 Missionaries and 3 Cannibals on the Left Shore, 0 Missionaries and 0 Cannibals on the Right Shore

Step 2:
2 Missionaries and 2 Cannibals on the Left Shore, 1 Missionaries and 1 Cannibals on the Right Shore

Step 3:
3 Missionaries and 2 Cannibals on the Left Shore, 0 Missionaries and 1 Cannibals on the Right Shore

Step 4:
2 Missionaries and 1 Cannibals on the Left Shore, 1 Missionaries and 2 Cannibals on the Right Shore

Step 5:
2 Missionaries and 2 Cannibals on the Left Shore, 1 Missionaries and 1 Cannibals on the Right Shore

Step 6:
1 Missionaries and 1 Cannibals on the Left Shore, 2 Missionaries and 2 Cannibals on the Right Shore

Step 7:
3 Missionaries and 1 Cannibals on the Left Shore, 0 Missionaries and 2 Cannibals on the Right Shore

Step 8:
2 Missionaries and 0 Cannibals on the Left Shore, 1 Missionaries and 3 Cannibals on the Right Shore

Step 9:
2 Missionaries and 1 Cannibals on the Left Shore, 1 Missionaries and 2 Cannibals on the Right Shore

Step 10:
1 Missionaries and 0 Cannibals on the Left Shore, 2 Missionaries and 3 Cannibals on the Right Shore

Step 11:
1 Missionaries and 1 Cannibals on the Left Shore, 2 Missionaries and 2 Cannibals on the Right Shore
```