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Artificial Intelligence
Practical 8
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Subject: Artificial Intelligence

Practical 8: Water Jug

Q1) Demonstrate Water Jug Problem.

Ans:

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 """
jug_water.py
Author: Jagrut Gala
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Practical: 9
Objective: Demonstrate Jug Water Problem and Solve it.
"""
from collections import deque

def BFS(a, b, target):
    """Map is used to store the states, every
    state is hashed to binary value to
    indicate either that state is visited
    before or not"""
    m = {}
    isSolvable = False
    path = []

    # Queue to maintain states
    q = deque()
    # Initialing with initial state
    q.append((0, 0))
    while (len(q) > 0):
        # Current state
        u = q.popleft()
        #q.pop() #pop off used state
        # If this state is already visited
        if ((u[0], u[1]) in m):
            continue
        # Doesn't met jug constraints
        if ((u[0] > a or u[1] > b or
            u[0] < 0 or u[1] < 0)):
            continue
        # Filling the vector for constructing
        # the solution path
        path.append([u[0], u[1]])
        # Marking current state as visited
        m[(u[0], u[1])] = 1
        # If we reach solution state, put ans=1
        if (u[0] == target or u[1] == target):
            isSolvable = True
            if (u[0] == target):
```

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                if (u[1] != 0):

                    # Fill final state
                    path.append([u[0], 0])
            else:
                if (u[0] != 0):
                    # Fill final state
                    path.append([0, u[1]])
            # Print the solution path
            sz = len(path)
            for i in range(sz):
                print("(", path[i][0], ",",
                        path[i][1], ")")
            break
        # If we have not reached final state
        # then, start developing intermediate
        # states to reach solution state
        q.append([u[0], b]) # Fill Jug2
        q.append([a, u[1]]) # Fill Jug1
        for ap in range(max(a, b) + 1):
            # Pour amount ap from Jug2 to Jug1
            c = u[0] + ap
            d = u[1] - ap
            # Check if this state is possible or not
            if (c == a or (d == 0 and d >= 0)):
                q.append([c, d])
            # Pour amount ap from Jug 1 to Jug2
            c = u[0] - ap
            d = u[1] + ap
            # Check if this state is possible or not
            if ((c == 0 and c >= 0) or d == b):
                q.append([c, d])
        # Empty Jug2
        q.append([a, 0])
        # Empty Jug1
        q.append([0, b])
    # No, solution exists if ans=0
    if (not isSolvable):
        print ("No solution")

# Driver code
if __name__ == '__main__':

    Jug1, Jug2, target = 4, 3, 2
    print("Path from initial state to solution state :")

    BFS(Jug1, Jug2, target)
```

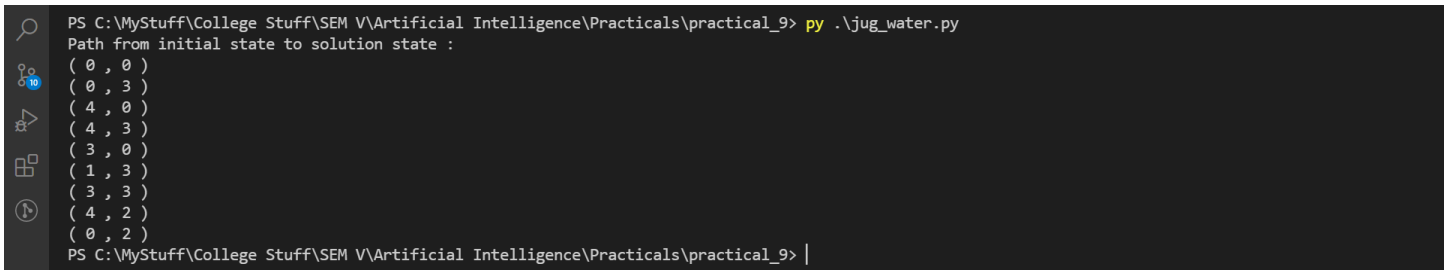
PS C:\MyStuff\College Stuff\SEM V\Artificial Intelligence\Practicals\practical_9> py .\jug_water.py
Path from initial state to solution state :
(0 , 0)
(0 , 3)
(4 , 0)
(4 , 3)
(3 , 0)
(1 , 3)
(3 , 3)
(4 , 2)
(0 , 2)
PS C:\MyStuff\College Stuff\SEM V\Artificial Intelligence\Practicals\practical_9>