EXP NO: 01

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WATER JUG PROBLEM

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AIM:

To solve the water jug problem using BFS and DFS.

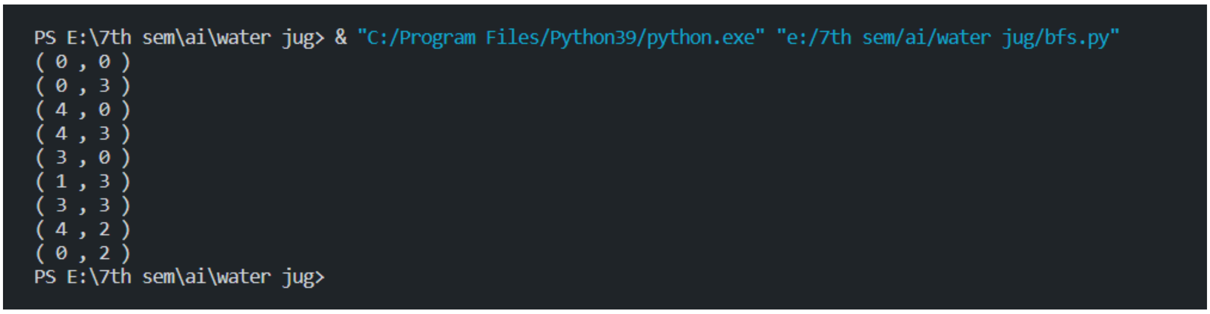
Problem: There are two jugs of volume A litre and B litre. Neither has any measuring mark on it.There is a pump that can be used to fill the jugs with water. How can you get exactly x litre of water into the A litre jug. Assuming that we have unlimited supply of water.

Note:Let's assume we have A=4 litre and B= 3 litre jugs. And we want exactly 2 Litre water into jug A (i.e 4 litre jug) how we will do this.

BFS

```
from collections import deque
def BFS(a, b, target):
    pathMap = {}
    isSolvable = False
    path = []
    q = deque()
    q.append((0, 0))
    while (len(q) > 0):
        curr = q.popleft()
        if ((curr[0], curr[1]) in pathMap):
            continue
        if ((curr[0] > a or curr[1] > b or
                curr[0] < 0 or curr[1] < 0)):
            continue
        path.append([curr[0], curr[1]])
        pathMap[(curr[0], curr[1])] = 1
        if (curr[0] == target or curr[1] == target):
            isSolvable = True
            if (curr[0] == target):
                if (curr[1] != 0):
                    path.append([curr[0], 0])
            else:
                if (curr[0] != 0):
                    path.append([0, curr[1]])
            sz = len(path)
            for i in range(sz):
                print("(", path[i][0], ",",
                      path[i][1], ")")
            break
        q.append([curr[0], b])
        q.append([a, curr[1]])
        for ap in range(max(a, b) + 1):
            c = curr[0] + ap
            d = curr[1] - ap
            if (c == a or (d == 0 and d >= 0)):
                q.append([c, d])

            c = curr[0] - ap
            d = curr[1] + ap

            if ((c == 0 and c >= 0) or d == b):
                q.append([c, d])

        q.append([a, 0])
        q.append([0, b])

    if (not isSolvable):
        print("No solution")


if __name__ == '__main__':
    Jug1, Jug2, target = 4, 3, 2
    BFS(Jug1, Jug2, target)
```

Output:

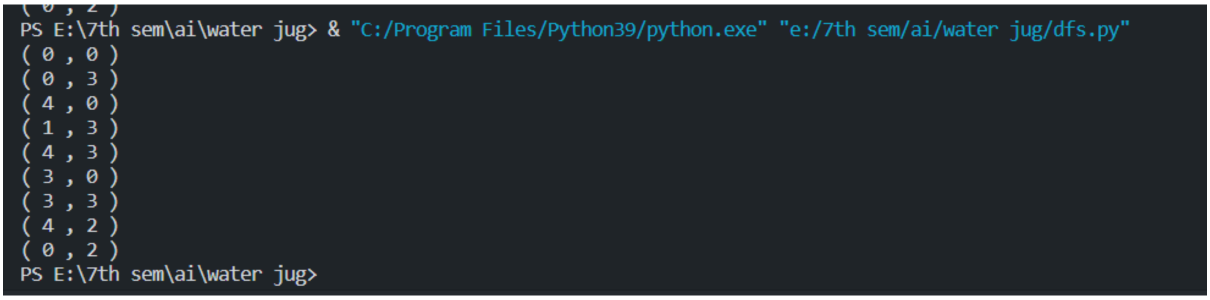


```
PS E:\7th sem\ai\water jug> & "C:/Program Files/Python39/python.exe" "e:/7th sem/ai/water jug/bfs.py"
( 0 , 0 )
( 0 , 3 )
( 4 , 0 )
( 4 , 3 )
( 3 , 0 )
( 1 , 3 )
( 3 , 3 )
( 4 , 2 )
( 0 , 2 )
PS E:\7th sem\ai\water jug>
```

DFS

```
from collections import deque


def DFS(a, b, target):
    pathMap = {}
    isSolvable = False
    path = []
    stack = []
    stack.append((0, 0))
    while (len(stack) > 0):
        curr = stack.pop()
        if ((curr[0], curr[1]) in pathMap):
            continue
        if ((curr[0] > a or curr[1] > b or
                curr[0] < 0 or curr[1] < 0)):
            continue
        path.append([curr[0], curr[1]])

        pathMap[(curr[0], curr[1])] = 1
        if (curr[0] == target or curr[1] == target):
            isSolvable = True
            if (curr[0] == target):
                if (curr[1] != 0):
                    path.append([curr[0], 0])
            else:
                if (curr[0] != 0):
                    path.append([0, curr[1]])
            sz = len(path)
            for i in range(sz):
                print("(", path[i][0], ",",
                      path[i][1], ")")
            break

        stack.append([curr[0], b])
        stack.append([a, curr[1]])

        for ap in range(max(a, b) + 1):

            c = curr[0] + ap
            d = curr[1] - ap

            if (c == a or (d == 0 and d >= 0)):
                stack.append([c, d])

            c = curr[0] - ap
            d = curr[1] + ap

            if ((c == 0 and c >= 0) or d == b):
                stack.append([c, d])

        stack.append([a, 0])
        stack.append([0, b])

    if (not isSolvable):
        print("No solution")


if __name__ == '__main__':
    Jug1, Jug2, target = 4, 3, 2
    DFS(Jug1, Jug2, target)
```

Output:



```
( 0 , 2 )
PS E:\7th sem\ai\water jug> & "C:/Program Files/Python39/python.exe" "e:/7th sem/ai/water jug/dfs.py"
( 0 , 0 )
( 0 , 3 )
( 4 , 0 )
( 1 , 3 )
( 4 , 3 )
( 3 , 0 )
( 3 , 3 )
( 4 , 2 )
( 0 , 2 )
PS E:\7th sem\ai\water jug>
```