

Name of Student	SHRIA SRIVASTAVA			Roll No.	2019140064
Lab Expt. No.	1	Batch	D	Date	4-10-2021
Expt. Title	Water Jug Problem				

Objectives

Water Jug Problem:

You are given two jugs, a 4-gallon one and a 3-gallon one. Neither has any measuring markers 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 the 4-gallon jug?

- 1- Define Task Environment for the water jug agent
- 2- Implement the agent function using simple defined rules using If-else statements.
- 3- Expected output is the solution path or sequence of actions following to get the solution.

One possible solution sequence :

- Fill 4 gallon jug fully with water.
- Pour some water from 4-gallon jug to 3-gallon jug until the 3-gallon jug is full.
- Empty the 3-gallon jug.
- Pour all water from 4-gallon jug to 3-gallon jug.
- Fill 4-gallon jug fully with water
- Pour some water from 4-gallon jug to 3-gallon jug until 3-gallon jug is full.

Production Rules :

- $(x,y / x < 4) \rightarrow (4,y)$ ----- Fill the 4-gallon jug.
- $(x,y / y < 3) \rightarrow (x,3)$ ----- Fill the 3-gallon jug
- $(x,y / x > 0) \rightarrow (x-d,y)$ ----Pour some water out of the 4-gallon jug
- $(x,y / y > 0) \rightarrow (x,y-d)$ -----Pour some water out of the 3-gallon jug
- $(x,y / y > 0) \rightarrow (x,0)$ ----- Empty the 3-gallon jug on ground.
- $(x,y / x+y \geq 4 \wedge y > 0) \rightarrow (4,y-(4-x))$ -----remove water from 3-gallon jug to the 4-gallon jug until the 4-gallon jug is full.

Implementation

Language : Python 3

Code:

```
def solution():
    x= input("Enter Jug 1 Capacity : ");    #taking capacity inputs for the jugs
    y= input("Enter Jug 2 Capacity : ");
    A = int(0); B=int(0);

    print("Initial State") #defining the initial state when jars have no water
    print("Amount of water in Jug 1 and Jug 2: "+"("+str(A)+","+str(B)+")");
    print("Jug 1: "+str(A))
    print("Jug 2: "+str(B))
    print()
    print("Goal : Jug 1 should have exactly 2 gallons of water\n");

    print("\n\n\t\t\t Solution 1 \n")
    A=4;
    print("Filling Jug 1 with 4 gallons completely");
    print("Amount of water in Jug 1 and Jug 2: "+"("+str(A)+","+str(B)+")");
    print("Jug 1: "+str(A)) #printing jug 1 quantity
    print("Jug 2: "+str(B))  #printing jug 2 quantity
    print()

    if(A+B>=3 and A>0):    #jug 1 has some water which is transferred to jug 2 until jug 2 is full
        print("Filling Jug 2 with 3 gallons from Jug 1 until Jug 2 is completely filled");
        A = 1;
        B = 3;
        print("Amount of water in Jug 1 and Jug 2: "+"("+str(A)+","+str(B)+")");
        print("Jug 1: "+str(A))
        print("Jug 2: "+str(B))
        print()

    if(B>0): #remove water from jug 2
        B=0;
        print("Emptying Jug 2 completely");
        print("Amount of water in Jug 1 and Jug 2: "+"("+str(A)+","+str(B)+")");
        print("Jug 1: "+str(A))
        print("Jug 2: "+str(B))
        print()

    if(A+B<=3 and A>0):
```

```
B=A;
A=0;
print("Filling Jug 2 with water remaining from Jug 1");
print("Amount of water in Jug 1 and Jug 2: "+"( "+str(A)+" "+str(B)+" )");
print("Jug 1: "+str(A)) #printing jug 1 quantity
print("Jug 2: "+str(B)) #printing jug 2 quantity
print()

if(A<4): #jug 1 is filled until full
    A=4
    print("Filling Jug 1 completely");
    print("Amount of water in Jug 1 and Jug 2: "+"( "+str(A)+" "+str(B)+" )");
    print("Jug 1: "+str(A)) #printing jug 1 quantity
    print("Jug 2: "+str(B))
    print()

if(A+B>=3 and A>0): #making jug 2 full
    A=A-(3-B);
    B=A+B;
    print("Filling Jug 2 with 2 gallons that will make Jug 2 full");
    print("Amount of water in Jug 1 and Jug 2: "+"( "+str(A)+" "+str(B)+" )");
    print("Jug 1: "+str(A)) #printing jug 1 quantity
    print("Jug 2: "+str(B)) #printing jug 2 quantity
    print()
    print("GOAL ACHEIVED , jug 1 has exactly 2 gallons")

print("\n\n\t\t\tSolution 2 \n") #Solution 2
A = 0;
B = 0;

if(B<3): #filling jug2
    B=3;
    print("Filling Jug 2 completely");
    print("Amount of water in Jug 1 and Jug 2: "+"( "+str(A)+" "+str(B)+" )");
    print("Jug 1: "+str(A))
    print("Jug 2: "+str(B))
    print()

if(A+B<=4 and B>0): #checking if jug 2 has water and transferring all of it to jug 1
    A=B;
    B-=B;
    print("Pouring all water from jug Jug 2 into jug 1");
    print("Amount of water in Jug 1 and Jug 2: "+"( "+str(A)+" "+str(B)+" )");
    print("Jug 1: "+str(A)) #printing jug 1 quantity
    print("Jug 2: "+str(B)) #printing jug 2 quantity
    print()

if(B<3): #filling jug 2
```

```
B=3;
print("Filling Jug 2 completely");
print("Amount of water in Jug 1 and Jug 2: "+"( "+str(A)+" "+str(B)+" )");
print("Jug 1: "+str(A)) #printing jug 1 quantity
print("Jug 2: "+str(B))  #printing jug 2 quantity
print()
```

```
if(A+B>=4 and B>0):
    print("Filling Jug 1 completely from Jug 2");
    B=2
    A=4; #A becomes full
    print("Amount of water in Jug 1 and Jug 2: "+"( "+str(A)+" "+str(B)+" )");
    print("Jug 1: "+str(A))
    print("Jug 2: "+str(B))
    print()
```

```
if(A>0):
    print("Emptying Jug 1 completely");
    A=0;
    print("Amount of water in Jug 1 and Jug 2: "+"( "+str(A)+" "+str(B)+" )");
    print("Jug 1: "+str(A))
    print("Jug 2: "+str(B))
    print()
```

```
if(A+B<=4 and B>0):
    print("Filling Jug 1 completely from Jug 2");
    A=A+B;
    B-=B;
    print("Amount of water in Jug 1 and Jug 2: "+"( "+str(A)+" "+str(B)+" )");
    print("Jug 1: "+str(A)) #jug 1 quantity
    print("Jug 2: "+str(B)) #jug 2 quantity
    print()
    print("GOAL ACHEIVED , jug 1 has exactly 2 gallons")
```

```
solution();    #calling the function
```

Output:

```
Enter Jug 1 Capacity : 4
Enter Jug 2 Capacity : 3
Initial State
Amount of water in Jug 1 and Jug 2: (0,0)
Jug 1: 0
Jug 2: 0

Goal : Jug 1 should have exactly 2 gallons of water

                        Solution 1

Filling Jug 1 with 4 gallons completely
Amount of water in Jug 1 and Jug 2: (4,0)
Jug 1: 4
Jug 2: 0

Filling Jug 2 with 3 gallons from Jug 1 until Jug 2 is completely filled
Amount of water in Jug 1 and Jug 2: (1,3)
Jug 1: 1
Jug 2: 3

Emptying Jug 2 completely
Amount of water in Jug 1 and Jug 2: (1,0)
Jug 1: 1
Jug 2: 0

Filling Jug 2 with water remaining from Jug 1
Amount of water in Jug 1 and Jug 2: (0,1)
Jug 1: 0
Jug 2: 1

Filling Jug 1 completely
Amount of water in Jug 1 and Jug 2: (4,1)
Jug 1: 4
Jug 2: 1

Filling Jug 2 with 2 gallons that will make Jug 2 full
Amount of water in Jug 1 and Jug 2: (2,3)
Jug 1: 2
Jug 2: 3

GOAL ACHEIVED , jug 1 has exactly 2 gallons
```

```
Solution 2

Filling Jug 2 completely
Amount of water in Jug 1 and Jug 2: (0,3)
Jug 1: 0
Jug 2: 3

Pouring all water from jug Jug 2 into jug 1
Amount of water in Jug 1 and Jug 2: (3,0)
Jug 1: 3
Jug 2: 0

Filling Jug 2 completely
Amount of water in Jug 1 and Jug 2: (3,3)
Jug 1: 3
Jug 2: 3

Filling Jug 1 completely from Jug 2
Amount of water in Jug 1 and Jug 2: (4,2)
Jug 1: 4
Jug 2: 2

Emptying Jug 1 completely
Amount of water in Jug 1 and Jug 2: (0,2)
Jug 1: 0
Jug 2: 2

Filling Jug 1 completely from Jug 2
Amount of water in Jug 1 and Jug 2: (2,0)
Jug 1: 2
Jug 2: 0

GOAL ACHEIVED , jug 1 has exactly 2 gallons
```

PERFORMANCE MEASURE:

If the target jug (j1) is filled with target amount of water (2 gallons) or not

Environment of Agent:

The jugs and their water levels are the environment for the agent

Actuators:

The actions that can be taken according to the production rules are the actuators.

Sensors:

The program itself that keeps the track of the water levels in the two jugs is the sensor.

Conclusion

In this experiment, I've understood and implemented the given water jug problem by using an intelligent agent function which uses the production rules as mentioned . The task environment is also defined for the same.