LAB-2

PRELAB:

1. Write an algorithm to solve the water jug problem?

2- JUG PROBLEM ALGORITM:

STEP1:START

STEP2:Read the initial values of the container a,b

STEP3:Read the container capacities x,y

STEP4:Read the goal state of the container g

STEP5:

5.1 :While(True):

5.1.1 :READ THE RULE NO

5.1.1.1

:if(ruleno=

=1): if a<x

: a=x

if(ruleno=

=2): if

b<y:b=y

if(ruleno

==3): if

a>0:a=0

if(ruleno

==4): if

b>0:b=0

if(ruleno

==5):

```
if a+b>x and b>0:a,b=x,b-(x-a)
    if(ruleno==6): if a+b>=y
      and a>0:a,b=a-(x-b),y
      if(ruleno==7):
      if a+b<=x and
      b>0:a,b=a+b,0
      if(ruleno==8): if
      a+b<=y and
      a>0:a,b=0,a+b
      print("A=",a)
      print("B=",b) if(a==z
      and b==0):
      print("The goal state is
          reached") break
```

STEP6:STOP

3- JUG PROBLEM ALGORITHM:

STEP1:START

STEP2:Read the initial values of the container a,b,c

STEP3:Read the container capacities x,y,z

STEP4:Read the goal state of the container g

STEP5:

5.1 :While(True):

5.1.1 :Read the rule number

5.1.1.1:if(ruleno==1): if a<x : a=x

if(ruleno==2): if a+b<x and c>0

:a,b,c=a,a-c,y-a

if(ruleno==3):

if a==x and b+c==0:a,b,c=x-y,y,c

if(ruleno==4):

if a+b==x and c==0:a,b,c=a-z,b,z

if(ruleno==5):

if a+b==y and c>0:a,b,c=y,x-(b+c),c

if(ruleno==6):

if a+b>y and c>0:a,b,c=a+b,y-b,c;

if(ruleno==7):

if a+b<y and c>0:a,b,c=a,y,c-b

if(ruleno==8):

if a+b<x and b==0:a,b,c=a,c,x-(a+c)

if(ruleno==9):

if b+c<=x and c==0:a,b,c=y-2*(x-y),y,x-y

print("A=",a)

print("B=",b)

print("C=",c)

if(a==g or b==g or c==g):

print("The goal state is reached") break

STEP6:STOP

2. You have two jugs with capacities x and y liters. There is an infinite amount of water supply available to you. Now you need to determine whether it is possible to measure z liters using these two jugs. If z liters of water are measurable, you must have z liters contained within one or both jugs by the end. We can do these few operations − • Fill any of the jugs fully with water.
- Empty any of the jugs.
- Pour water from one jug into another till the other jug is completely full or the first jug itself is empty.

SOLUTION

We have jugs x and y . Now According to Extended Euclidean theorem

if gcd(x, y) = a

then we can write a as

mx + ny = a

now if z % a == 0 then z = ka

mx + ny = ka or m (x/k) + n(y/k) = 1

here x/k and y/k are integers

now m and n according to extended euclidean theorem are integers

lets suppose than when m or n is positive it means adding water to the jug

and when m or n is negative it means removing or emptying the jug

so our requrement is

$mx + ny = z$

we have already found tha

$m(x/k) + n(y/k) = 1$

mutliplying both side by z

we have

$mz(x/k) + n(y/k)*z = z$

which means that we can measure water upto z litres using jugs of size(x/k) and

(y/k)

so we will return true if z%(gcd(x, y)) == 0 of course when gcd(x,y) ==0 we would have to consider certain cases

As a cororolly to the problem we can establish that given x and y such that

gcd(x,y) ==1 or x and y are coprime .In such a configuration we can measure upto any capacity that is any z greater than 0 and less than or equal to x +y.

IN LAB:

1. A Water Jug Problem with 2 gallons: You are given two jugs, a 5-gallon one and a 4-gallon one, a pump which can supply unlimited water that can be used to fill the jugs, and a ground on which water can be disposed. Neither jug has any measuring markings on it. Implement a python code to get exactly 2 gallons of water in the 5-gallon jug.

CODE:

In [1]:
```
print("Water Jug Problem")
x = int(input('Enter x:'))
y = int(input('Enter y:'))
while True:
    rule = int(input('Enter the rule number: '))
    if(rule == 1):
        if x<5:
            x=5
    if(rule == 2):
        if y<4:
            y=4
    if(rule == 3):
        if x>0:
            x=0
    if(rule == 4):
        if y>0:
            y=0
    if(rule == 5):
        if x+y>=5 and y>0:
            x,y = 5,y-(5-x)
    if(rule == 6):
        if x+y>4 and y>0:
            x,y = x-(4-y),4
    if(rule == 7):
        if x+y<=5 and y>0:
            x,y = x+y,0
    if(rule == 8):
        if x+y<=4 and y>0:
            x,y = 0,x+y
    print('X=',x)
    print('Y=',y)
    if(x == 2):
        print("The result is goal state.")
        break
```

OUTPUT

```
Water Jug Problem
Enter x:0
Enter y:0
Enter the rule number: 2
X= 0
Y= 4
Enter the rule number: 7
X= 4
Y= 0
Enter the rule number: 2
X= 4
Y= 4
Enter the rule number: 5
X= 5
Y= 3
Enter the rule number: 3
X= 0
Y= 3
Enter the rule number: 7
X= 3
Y= 0
Enter the rule number: 2
X= 3
Y= 4
Enter the rule number: 5
X= 5
Y= 2
Enter the rule number: 3
X= 0
Y= 2
Enter the rule number: 7
X= 2
Y= 0
The result is goal state.
```

POST LAB:

1. A Water jug problem with 3 gallon: You are given three jugs, a 12-gallon one and an 8-gallon one and a 5-gallon one, a pump which can supply unlimited water that can be used to fill the jugs, and a ground on which water can be disposed. Neither jug has any measuring markings on it. Implement a python code to get exactly 6 gallons of water in any of the jug.

CODE:

In [1]:
```
print('Water Jug problem with 3 jugs: ')
x = int(input('Enter x: '))
y = int(input('Enter y: '))
z = int(input('Enter z: '))
a = int(input('Enter 1st Container Capacity: '))
b = int(input('Enter 2nd Container Capacity: '))
c = int(input('Enter 3rd Container Capacity: '))
g = int(input('Enter the Goal State Capacity: '))
while True:
    rule = int(input('Enter the rule no: '))
    if(rule == 1):
        if x<a:
            x = a
    if(rule == 2):
        if x+y<a and z>0:
            x,y,z = x,x-z,b-x
    if(rule == 3):
        if x==a and y+z==0:
            x,y,z=a-b,b,z
    if(rule == 4):
        if x+y==a and z==0:
            x,y,z=x-c,y,c
    if(rule == 5):
        if x+y==b and z>0:
            x,y,z=b,a-(y+z),z
    if(rule == 6):
        if x+y>b and z>0:
            x,y,z=x+y,b-y,z
    if(rule == 7):
        if x+y<b and z>0:
            x,y,z=x,b,z-y
    if(rule == 8):
        if x+y<a and y==0:
            x,y,z=x,z,a-(x+z)
    if(rule == 9):
        if y+z<=a and z==0:
            x,y,z=b-2*(a-b),b,a-b
    print('X=',x)
    print('Y=',y)
    print('Z=',z)
    if(x==g or b==g or c==g):
        print('The Goal state is reached.')
        break
```

OUTPUT

```
Water Jug problem with 3 jugs:
Enter x: 0
Enter y: 0
Enter z: 0
Enter 1st Container Capacity: 12
Enter 2nd Container Capacity: 8
Enter 3rd Container Capacity: 5
Enter the Goal State Capacity: 6
Enter the rule no: 1
X= 12
Y= 0
Z= 0
Enter the rule no: 3
X= 4
Y= 8
Z= 0
Enter the rule no: 9
X= 0
Y= 8
Z= 4
Enter the rule no: 5
X= 8
Y= 0
Z= 4
Enter the rule no: 8
X= 8
Y= 4
Z= 0
Enter the rule no: 4
X= 3
Y= 4
Z= 5
Enter the rule no: 7
X= 3
Y= 8
Z= 1
Enter the rule no: 6
X= 11
Y= 0
Z= 1
Enter the rule no: 8
X= 11
Y= 1
Z= 0
Enter the rule no: 4
X= 6
Y= 1
Z= 5
The Goal state is reached.
```