CSA17- Artificial Intelligence

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1. **Write the python program to solve 8-Puzzle problem**

```
import copy

from heapq import heappush, heappop

n = 3

rows = [ 1, 0, -1, 0 ]
cols = [ 0, -1, 0, 1 ]

class priorityQueue:

    def __init__(self):
        self.heap = []

    # Inserting a new key 'key'
    def push(self, key):
        heappush(self.heap, key)

    def pop(self):
        return heappop(self.heap)

    def empty(self):
        if not self.heap:
```

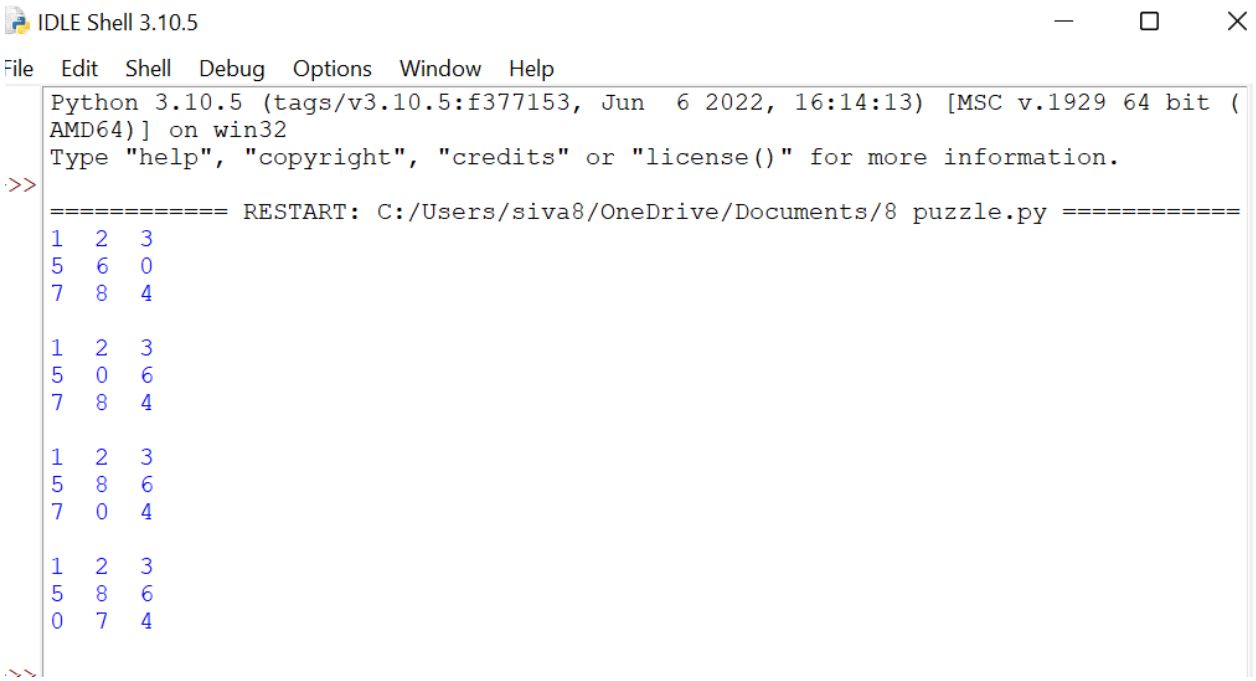
```
            return True
        else:
            return False

class nodes:

    def __init__(self, parent, mats, empty_tile_posi,
                 costs, levels):

        self.parent = parent

        self.mats = mats

        self.empty_tile_posi = empty_tile_posi

        self.costs = costs

        self.levels = levels


    def __lt__(self, nxt):
        return self.costs < nxt.costs

def calculateCosts(mats, final) -> int:

    count = 0
    for i in range(n):
        for j in range(n):
            if ((mats[i][j]) and
                (mats[i][j] != final[i][j])):
```

```
            count += 1

    return count

def newNodes(mats, empty_tile_posi, new_empty_tile_posi,
        levels, parent, final) -> nodes:

    new_mats = copy.deepcopy(mats)

    x1 = empty_tile_posi[0]
    y1 = empty_tile_posi[1]
    x2 = new_empty_tile_posi[0]
    y2 = new_empty_tile_posi[1]
    new_mats[x1][y1], new_mats[x2][y2] = new_mats[x2][y2],
new_mats[x1][y1]

    costs = calculateCosts(new_mats, final)

    new_nodes = nodes(parent, new_mats, new_empty_tile_posi,
            costs, levels)
    return new_nodes

def printMatsrix(mats):

    for i in range(n):
        for j in range(n):
            print("%d " % (mats[i][j]), end = " ")

        print()
```

```
def isSafe(x, y):

    return x >= 0 and x < n and y >= 0 and y < n

def printPath(root):

    if root == None:
        return

    printPath(root.parent)
    printMatsrix(root.mats)
    print()

def solve(initial, empty_tile_posi, final):

    pq = priorityQueue()

    costs = calculateCosts(initial, final)
    root = nodes(None, initial,
             empty_tile_posi, costs, 0)

    pq.push(root)


    while not pq.empty():

        minimum = pq.pop()

        if minimum.costs == 0:
```

```
            printPath(minimum)
            return

        for i in range(n):
            new_tile_posi = [
                minimum.empty_tile_posi[0] + rows[i],
                minimum.empty_tile_posi[1] + cols[i], ]

            if isSafe(new_tile_posi[0], new_tile_posi[1]):

                child = newNodes(minimum.mats,
                                 minimum.empty_tile_posi,
                                 new_tile_posi,
                                 minimum.levels + 1,
                                 minimum, final,)


                pq.push(child)


initial = [ [ 1, 2, 3 ],
            [ 5, 6, 0 ],
            [ 7, 8, 4 ] ]

final = [ [ 1, 2, 3 ],
          [ 5, 8, 6 ],
          [ 0, 7, 4 ] ]

empty_tile_posi = [ 1, 2 ]
```

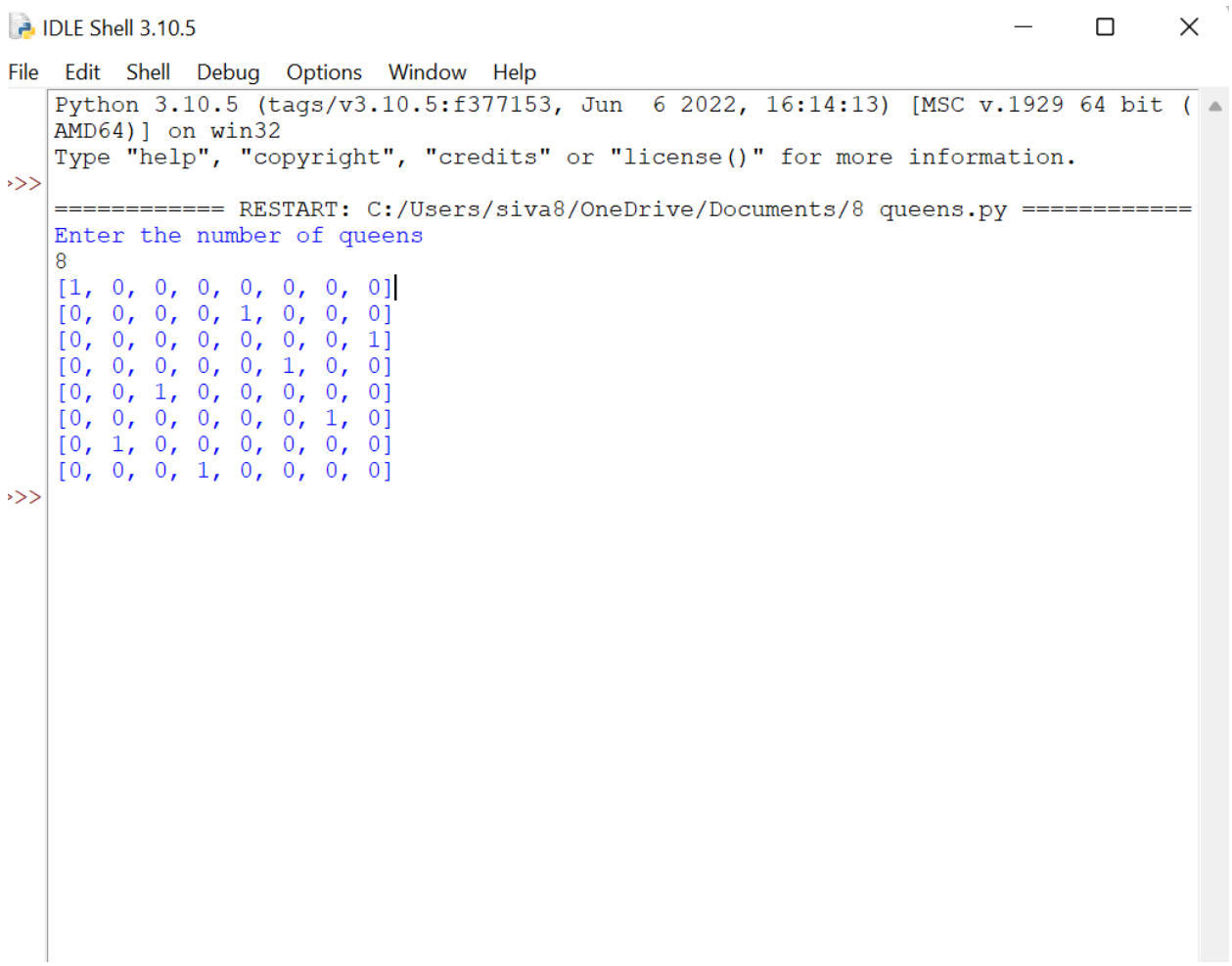
solve(initial, empty_tile_posi, final)



2. Write the python program to solve 8-Queen problem

```
print ("Enter the number of queens")
N = int(input())
board = [[0]*N for _ in range(N)]
def attack(i, j):
    for k in range(0,N):
        if board[i][k]==1 or board[k][j]==1:
            return True
    for k in range(0,N):
        for l in range(0,N):
```

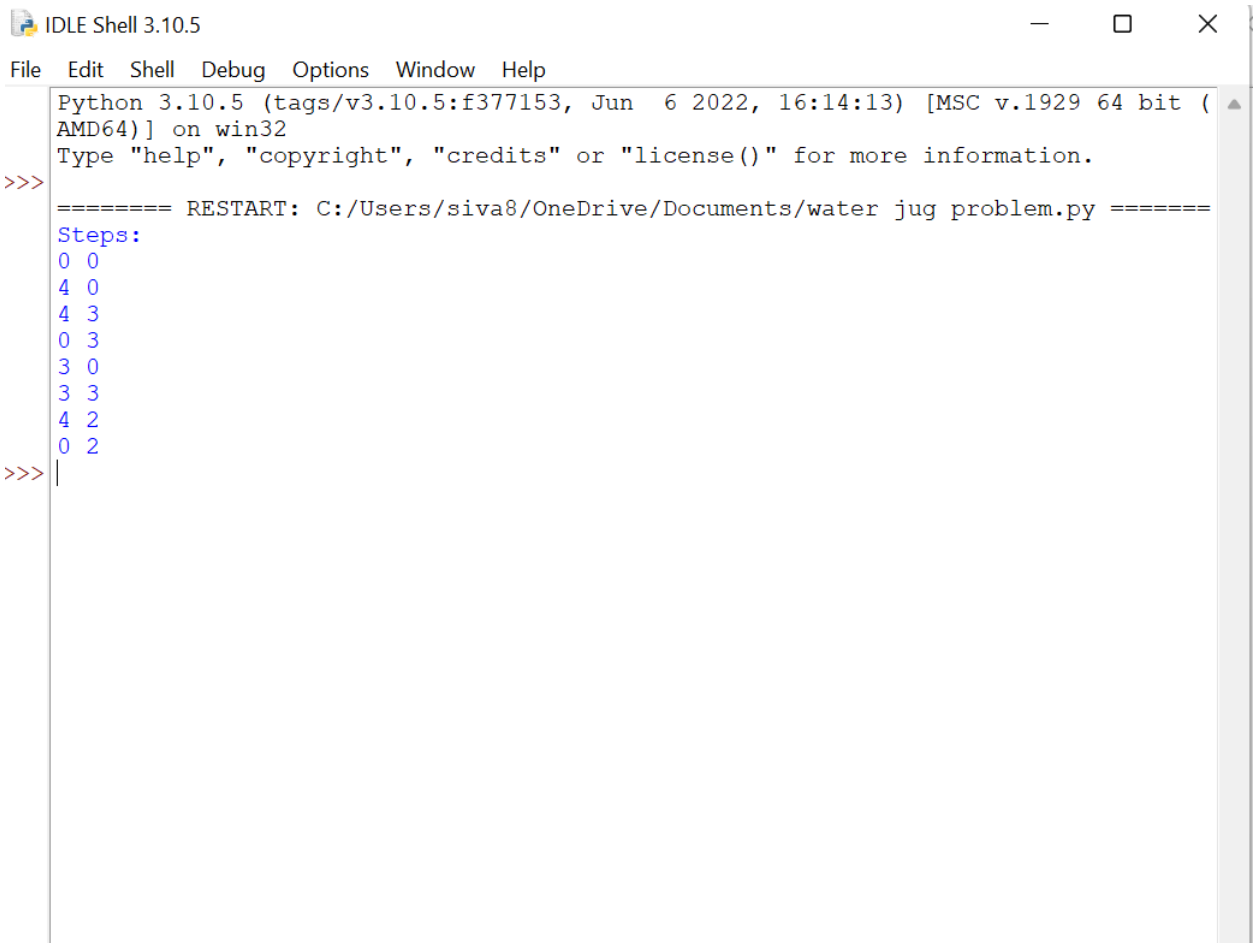
```
            if (k+l==i+j) or (k-l==i-j):
                if board[k][l]==1:
                    return True
    return False
def N_queens(n):
    if n==0:
        return True
    for i in range(0,N):
        for j in range(0,N):
            if (not(attack(i,j))) and (board[i][j]!=1):
                board[i][j] = 1
                if N_queens(n-1)==True:
                    return True
                board[i][j] = 0
    return False
N_queens(N)
for i in board:
    print (i)
```



3. Write the python program for Water Jug Problem

```
def waterJugSolver(amt1, amt2):

        if (amt1 == aim and amt2 == 0) or (amt2 == aim and amt1 ==
0):
                print(amt1, amt2)
                return True

        if visited[(amt1, amt2)] == False:
                print(amt1, amt2)
```

```
            visited[(amt1, amt2)] = True

            return (waterJugSolver(0, amt2) or
                        waterJugSolver(amt1, 0) or
                        waterJugSolver(jug1, amt2) or
                        waterJugSolver(amt1, jug2) or
                        waterJugSolver(amt1 + min(amt2, (jug1-
amt1)),
                        amt2 - min(amt2, (jug1-amt1))) or
                        waterJugSolver(amt1 - min(amt1, (jug2-
amt2)),
                        amt2 + min(amt1, (jug2-amt2))))

        else:
            return False

print("Steps: ")

waterJugSolver(0, 0)
```



4. Write the python program for Cript-Arithmetic problem

```
def isSolvable(words, result):
    mp = [-1]*(26)
    used = [0]*(10)

    Hash = [0]*(26)

    CharAtfront = [0]*(26)
    uniq = ""
```

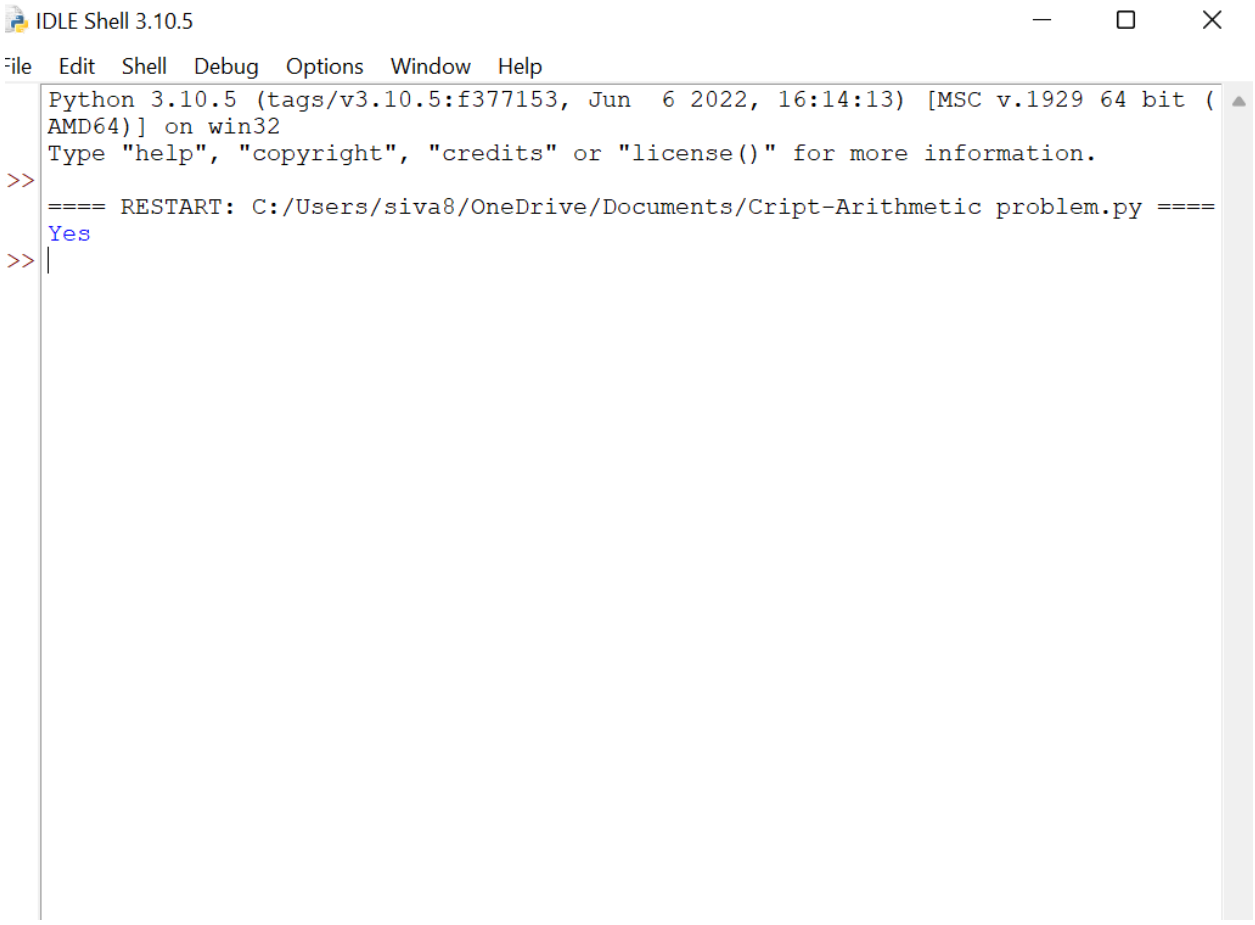
```
for word in range(len(words)):
    for i in range(len(words[word])):

        ch = words[word][i]
        Hash[ord(ch) - ord('A')] += pow(10, len(words[word]) - i - 1)

        if mp[ord(ch) - ord('A')] == -1:

            mp[ord(ch) - ord('A')] = 0

            uniq += str(ch)
        if i == 0 and len(words[word]) > 1:

            CharAtfront[ord(ch) - ord('A')] = 1
for i in range(len(result)):

    ch = result[i]


    Hash[ord(ch) - ord('A')] -= pow(10, len(result) - i - 1)

    if mp[ord(ch) - ord('A')] == -1:
```

```
            mp[ord(ch) - ord('A')] = 0

            uniq += str(ch)
        if i == 0 and len(result) > 1:

            CharAtfront[ord(ch) - ord('A')] = 1


    mp = [-1]*(26)

    return True


def solve(words, i, S, p, used, Hash, CharAtfront):
    if i == len(words):

        return S == 0


    ch = words[i]
```

```
    val = mp[ord(words[i]) - ord('A')]




    if val != -1:

        return solve(words, i + 1, S + val * Hash[ord(ch) - ord('A')], mp,
used, Hash, CharAtfront)

    x = False

    for l in range(10):

        if CharAtfront[ord(ch) - ord('A')] == 1 and l == 0:

            continue



        if used[l] == 1:

            continue
```

```
        mp[ord(ch) - ord('A')] = l

        used[l] = 1

        x |= solve(words, i + 1, S + l * Hash[ord(ch) - ord('A')], mp, used,
Hash, CharAtfront)

        mp[ord(ch) - ord('A')] = -1




        used[l] = 0



    return x


arr = [ "SIX", "SEVEN", "SEVEN" ]
```

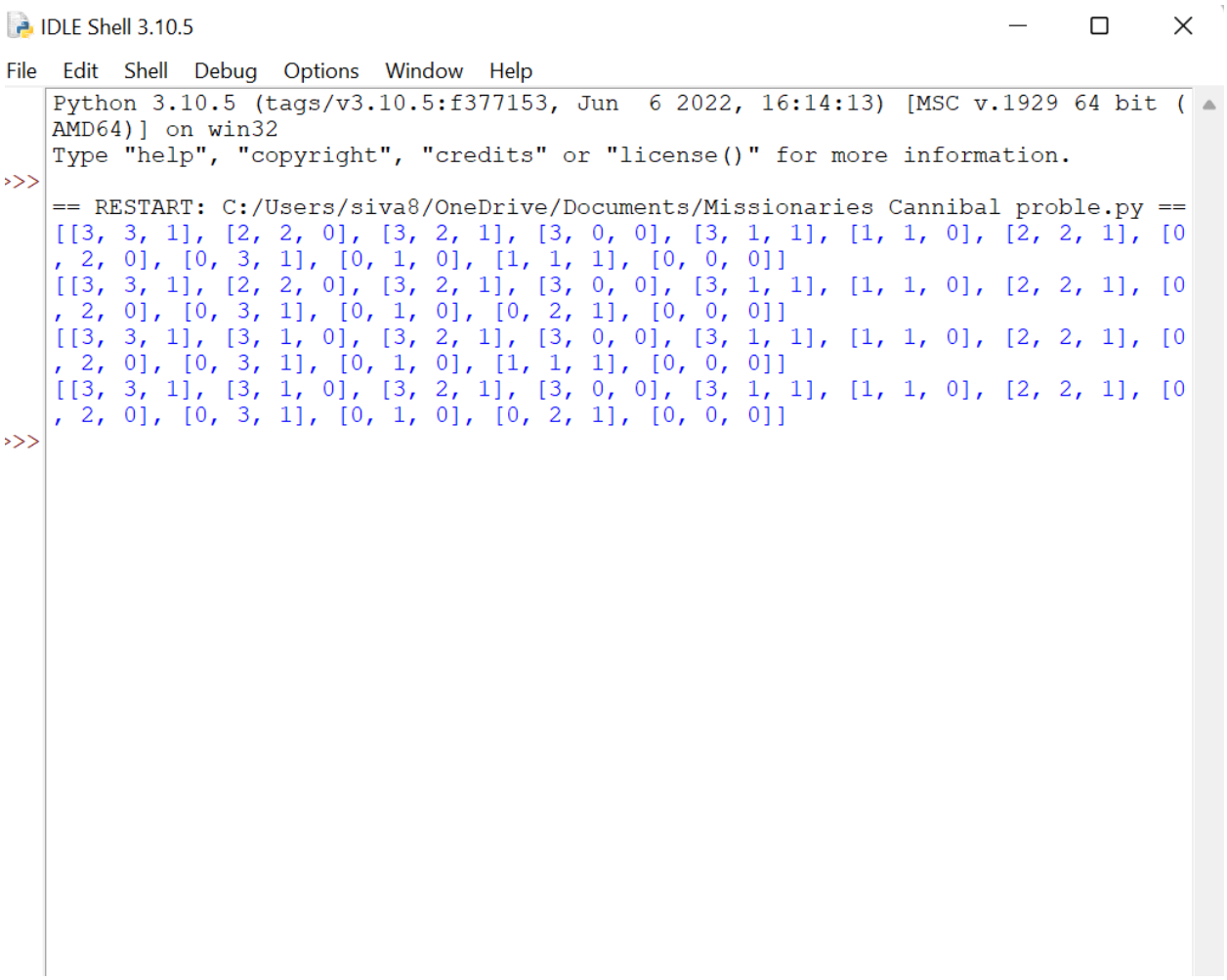
```
S = "TWENTY"

if isSolvable(arr, S):

    print("Yes")

else:

    print("No")
```



5. **Write the python program for Missionaries Cannibal problem**

```
start,end =[3,3,1],[0,0,0]
def do_action(state,action):
    if state[2] == 1:
        return [state[i] - action[i] for i in range(3)]
    else:
        return [state[i] + action[i] for i in range(3)]
def is_legal(state):
    if 0 <= state[0] <= 3 and 0 <= state[1] <= 3:
        return True
    else:
        return False
def is_bank_safe(bank):
    if bank[1] > bank[0] and bank[0] != 0:
        return False
    else:
        return True
def is_state_safe(state):
    other_bank = [start[i]-state[i] for i in range(3)]
    if is_bank_safe(state) and is_bank_safe(other_bank) :
        return True
    else:
        return False
def next_possible_actions(state):
    actions = [[1,0,1],[0,1,1],[1,1,1],[2,0,1],[0,2,1]]
    moves = []
    for i in actions:
        j = do_action(state,i)
        if is_legal(j) and is_state_safe(j):
```

```
            moves.append(j)
    return moves
solutions = []
def solve(next_action,path):
    _path = path.copy()
    if next_action == end:
        _path.append(next_action)
        solutions.append(_path)
        return
    elif next_action in path:
        return
    else:
        _path.append(next_action)
        for i in next_possible_actions(next_action):
            solve(i,_path)

solve([3,3,1],[])
print(*solutions,sep="\n")
```



6.Write the python program for Vacuum Cleaner problem

```
import random

def display(room):
   print(room)

room = [
   [1, 1, 1, 1],
   [1, 1, 1, 1],
   [1, 1, 1, 1],
   [1, 1, 1, 1],
]
```

```
print("All the rooom are dirty")
display(room)

x =0
y= 0

while x < 4:
   while y < 4:
      room[x][y] = random.choice([0,1])
      y+=1
   x+=1
   y=0
print("Before cleaning the room I detect all of these random
dirts")
display(room)
x =0
y= 0
z=0
while x < 4:
   while y < 4:
      if room[x][y] == 1:
         print("Vaccum in this location now,",x, y)
         room[x][y] = 0
         print("cleaned", x, y)
         z+=1
      y+=1
   x+=1
   y=0
pro= (100-((z/16)*100))
print("Room is clean now, Thanks for using : 3710933")
```

```
display(room)
print('performance=',pro,'%')S
```