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Sub : Analysis of Algorithm & Reasoning Computing **Paper : I**
Academic Year : 2022-23 **Sem : 1**

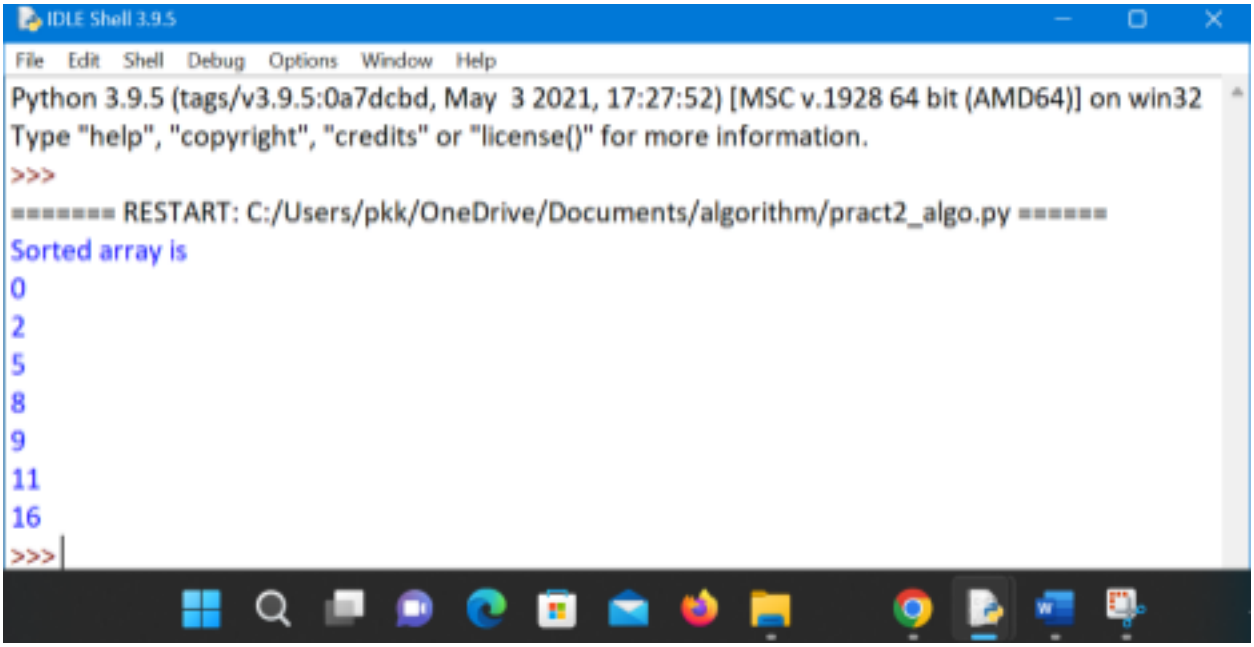
Q.1) Write a Program for Heap Sort Algorithm

```
Python program for

implementation of heapSort


# To heapify subtree

rooted at index i.

# n is size of heap

def heapify(arr, n, i):

    largest = i # Initialize largest as root

    l = 2 * i + 1 # left = 2*i + 1

    r = 2 * i + 2 # right = 2*i + 2



    # See if left child of root exists and is

    # greater than root

    if l < n and arr[i] < arr[l]:

        largest = l



    # See if right child of root exists and is

    # greater than root

    if r < n and arr[largest] < arr[r]:

        largest = r
```

```
    # Change root, if needed

    if largest != i:

        arr[i],arr[largest] = arr[largest],arr[i] # swap
        # Heapify the root.

        heapify(arr, n, largest)


# The main function to sort an

array of given size def

heapSort(arr):

    n = len(arr)


    # Build a maxheap.

    for i in range(n, -1, -1):

        heapify(arr, n, i)


    # One by one extract elements

    for i in range(n-1, 0, -1):

        arr[i], arr[0] =

        arr[0], arr[i] #

        swap heapify(arr, i,

        0)
```

```
# Driver code to test above

arr = [2,8,16,11,9,5,0]

heapSort(arr)

n = len(arr)

print ("Sorted array is")
for i in range(n):
    print ("%d" %arr[i]),
```

- **Output**



Q2) Write a Program to perform Radix Sort

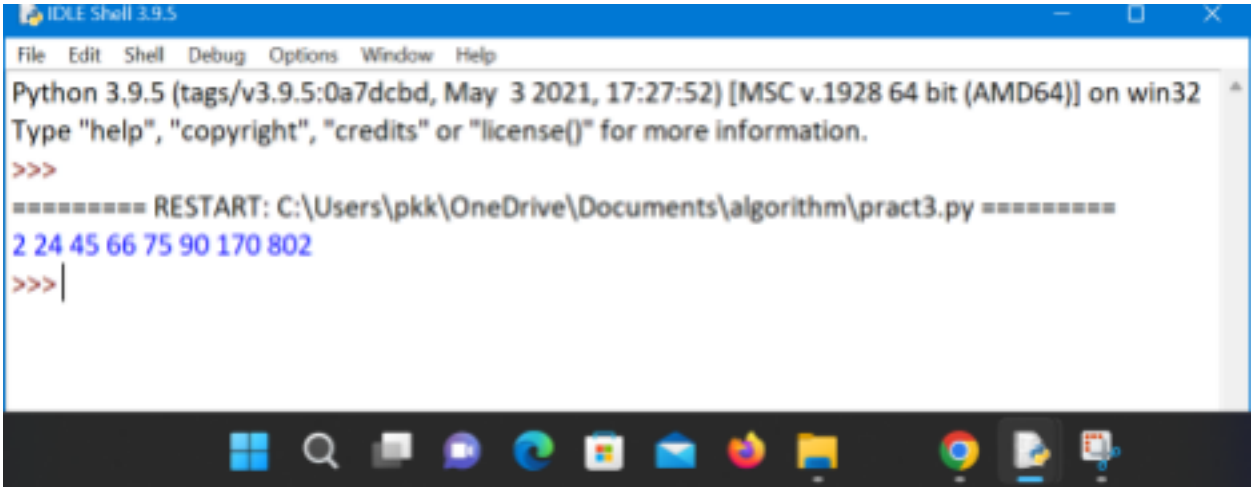
Algorithm

Python program for implementation of Radix Sort

```
# Python program for implementation of Radix Sort

# A function to do counting sort of arr[] according to

# the digit represented by exp.
```

```
def countingSort(arr, exp1):


      n = len(arr)

      output = [0] * (n)

      count = [0] * (10)
      for i in range(0, n):

            index = (arr[i]/exp1)

            count[int((index)%10)] += 1



      # Change count[i] so that count[i] now contains

      actual




      # position of this digit in output array

for i in range(1,10):

      count[i] += count[i-1]



# Build the output array

i = n-1

while i>=0:

      index = (arr[i]/exp1)
      output[ count[ int((index)%10) ] - 1] = arr[i]

      count[int((index)%10)] -= 1

      i -= 1



# Copying the output array to arr[],

i = 0
```

```
for i in range(0,len(arr)):
      arr[i] = output[i]



def radixSort(arr):
      max1 = max(arr)

      exp = 1

      while max1/exp > 0:

            countingSort(arr,exp)

            exp *= 10

arr = [ 170, 45, 75, 90, 802, 24, 2, 66]

radixSort(arr)



for i in range(len(arr)):

      print(arr[i],end=" ")
```

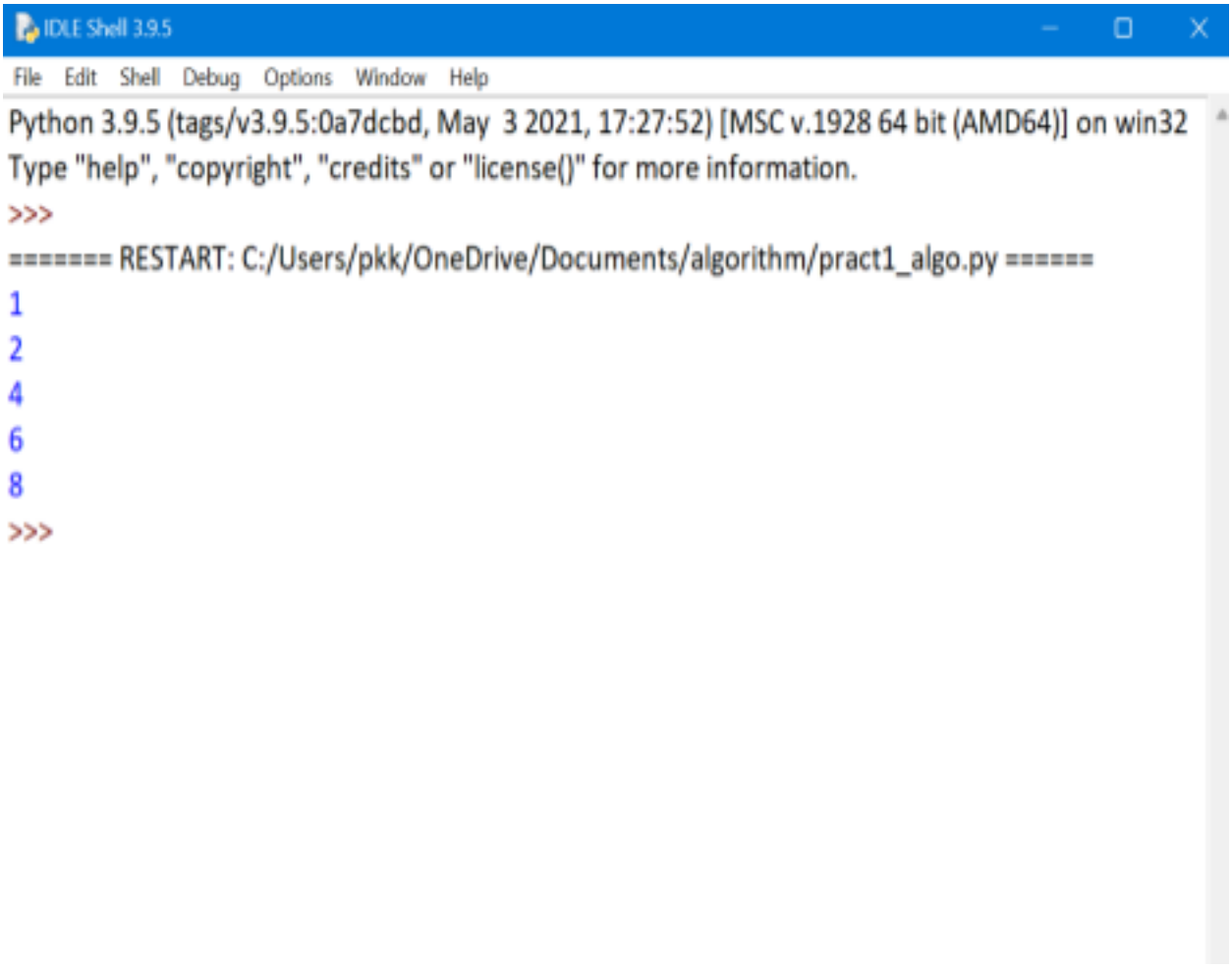


Q3) Write a Program for Randomized Selection Algorithm

```
from random import randrange
def partition(x, pivot_index = 0):
            i = 0
    if pivot_index !=0:
    x[0],x[pivot_index] =
    x[pivot_index],x[0] for j in
    range(len(x)-1):
        if x[j+1] < x[0]:
            x[j+1],x[i+1] = x[i+1],x[j+1]
            i += 1
    x[0],x[i] = x[i],x[0]
    return x,i


def RSelect(x,k):
    if len(x) == 1:
        return x[0]
    else:
        xpart = partition(x,randrange(len(x)))
        x = xpart[0] # partitioned array
       j = xpart[1] # pivot index
        if j == k:
            return x[j]
```

```
        elif j > k:
            return RSelect(x[:j],k)

        else:
            k = k - j - 1

            return RSelect(x[(j+1):], k)


x = [8,4,2,6,1]

for i in range(len(x)):

    print (RSelect(x,i))
```

Output :-



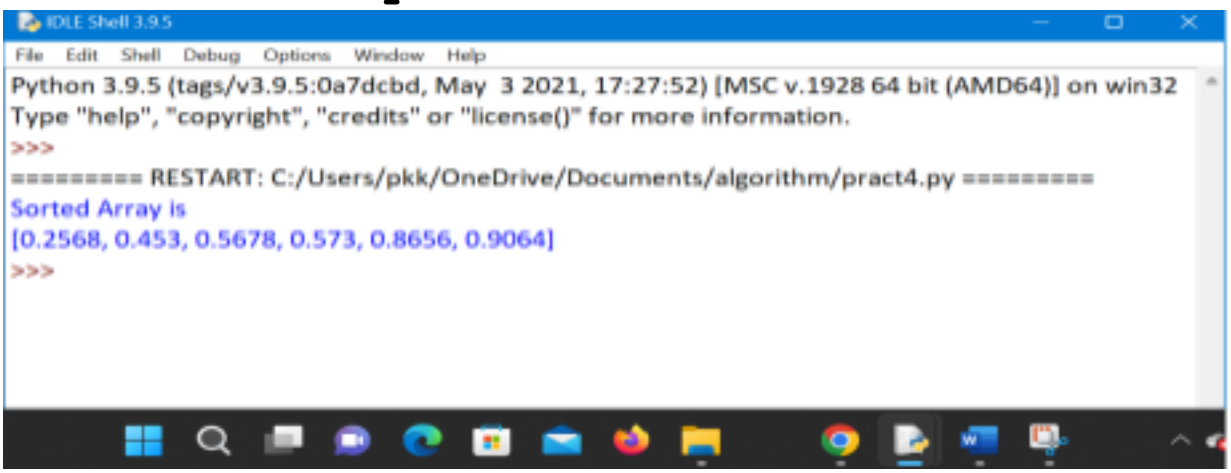
Q4) Write a Program to Perform Bucket Sort Algorithm

```
# Python3 program to sort an array
# using bucket sort

def insertionSort(b):
    for i in range(1, len(b)):
        up = b[i]
```

```
        j = i - 1

        while j >=0 and b[j] > up:

            b[j + 1] = b[j]

            j -= 1
        b[j + 1] = up


    return b

def bucketSort(x):

    arr = []

      slot_num = 10 # 10

     means 10 slots, each

     # slot's size is 0.1

    for i in range(slot_num):

        arr.append([])

    # Put array elements in

    different buckets for j
    in x:

        index_b = int(slot_num * j)

        arr[index_b].append(j)

    # Sort individual buckets

    for i in range(slot_num):

        arr[i] = insertionSort(arr[i])

    # concatenate the result

    k = 0

    for i in range(slot_num):
```

```
            for j in range(len(arr[i])):

                x[k] = arr[i][j]

                k += 1

        return x

# Driver Code

x = [0.453, 0.573, 0.8656, 0.9064, 0.5678, 0.2568]
print("Sorted Array is")

print(bucketSort(x))
```

Output :-



Q5) Write a Program to Perform Folyd-Warshall algorithm.

```
# Python Program for Floyd Warshall Algorithm

# Number of vertices in the graph

V = 4

# Define infinity as the large enough value.

This value will be # used for vertices not

connected to each other

INF = 99999
```

```
# Solves all pair shortest path via Floyd

Warshall Algorithm def

floydWarshall(graph):

   dist = map(lambda i : map(lambda j : j , i) , graph)

       for k in range(V):

# pick all vertices as source one by one

         for i in range(V):
# Pick all vertices as destination for the

# above picked source
             for j in range(V):

# If vertex k is on the shortest path from

# i to j, then update the value of dist[i][j]

                 dist[i][j] = min(dist[i][j]

     ,dist[i][k]+ dist[k][j])


                 printSolution(dist)

# A utility function to print the solution

def printSolution(dist):

     print "Following matrix shows the shortest distances\




between every pair of vertices"

     for i in range(V):

         for j in range(V):

             if(dist[i][j] == INF):
```

```
                    print "%7s" %("INF"),
                else:
                    print "%7d\t" %(dist[i][j]),
                if j == V-1:
                    print ""
        graph = [[0,5,INF,10],
                 [INF,0,3,INF],
                 [INF, INF, 0, 1],
                 [INF, INF, INF, 0]]
floydWarshall(graph);
```

Output:-

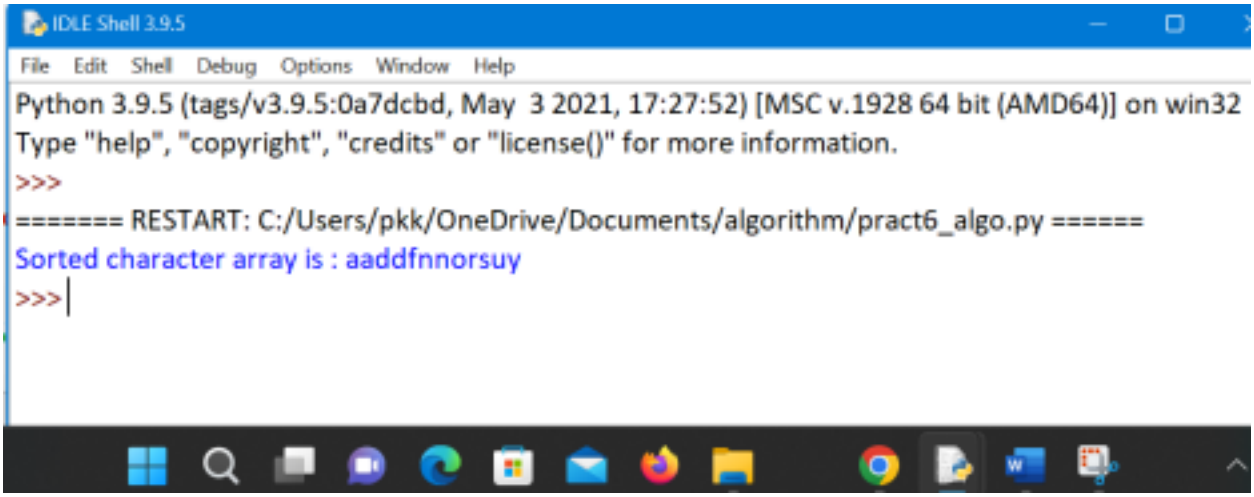
Q6) Write a Program for Counting Sort Algorithm in Python

```
Python program for counting sort

# The main function that sort the
given string arr[] in # alphabetical
order

def countSort(arr):

# The output character array that
    will have sorted arr output = [0
```

```
    for i in range(256)]

# Create a count array to store

count of inidividul # characters

and initialize count array as 0

count = [0 for i in range(256)]

# For storing the

resulting answer since the

# string is immutable

    ans = ["" for _ in arr]

# Store count of each character

    for i in arr:

        count[ord(i)] += 1

# Change count[i] so that count[i]

now contains actual # position of

this character in output array for i

in range(256):
        count[i] += count[i-1]

# Build the output character array

    for i in range(len(arr)):
         output[count[ord(arr[i])]-1] = arr[i]

        count[ord(arr[i])] -= 1



# Copy the output array to arr, so that arr now

# contains sorted characters

    for i in range(len(arr)):
```

```
            ans[i] = output[i]

        return ans

# Driver program to test above function

arr = "Sandfoundary"

ans = countSort(arr)

print "Sorted character array is %s" %("".join(ans))
```

Output :-

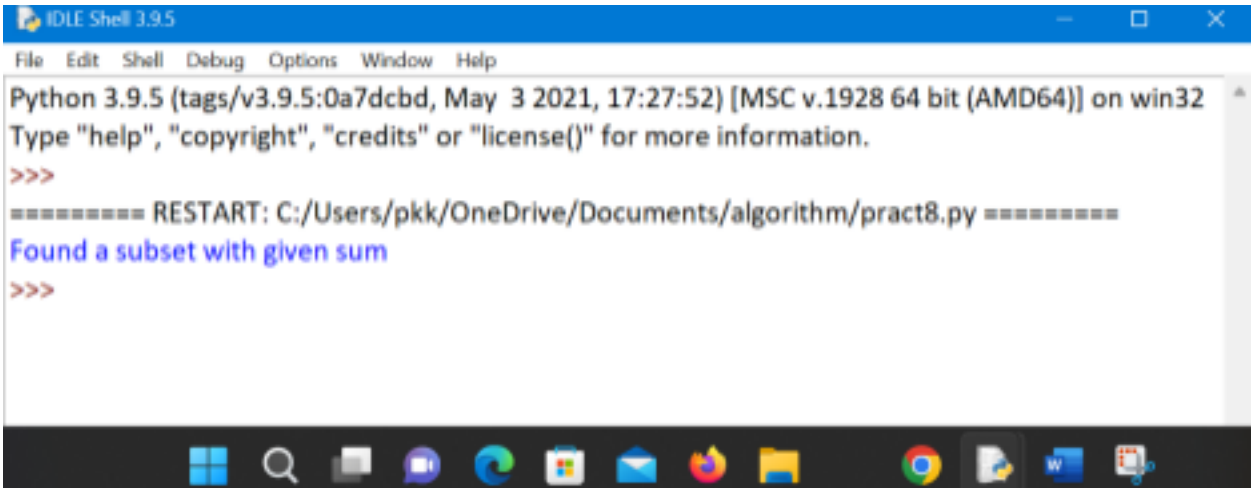


Q7) Write a Program for found a subset with given sum

```
# A recursive solution for subset sum

# problem

# Returns true if there is a subset

# of set[] with sun equal to given sum

def isSubsetSum(set,n, sum) :


      # Base Cases
```

```
      if (sum == 0) :

            return True

      if (n == 0 and sum != 0) :

          return False
      # If last element is greater than

      # sum, then ignore it

      if (set[n - 1] > sum) :

          return isSubsetSum(set, n - 1, sum);

                # else, check if sum can be obtained

                # by any of the following

                # (a) including the last element

                # (b) excluding the last element

      return isSubsetSum(set, n-1, sum) or isSubsetSum(set, n-1,
sum-set[n-1])


      # Driver program to test above function
set = [3, 34, 4, 12, 5, 2]

sum = 9

n = len(set)

if (isSubsetSum(set, n, sum) == True) :

      print("Found a subset with given sum")

            else :

                print("No subset with given sum")
```

Output :-

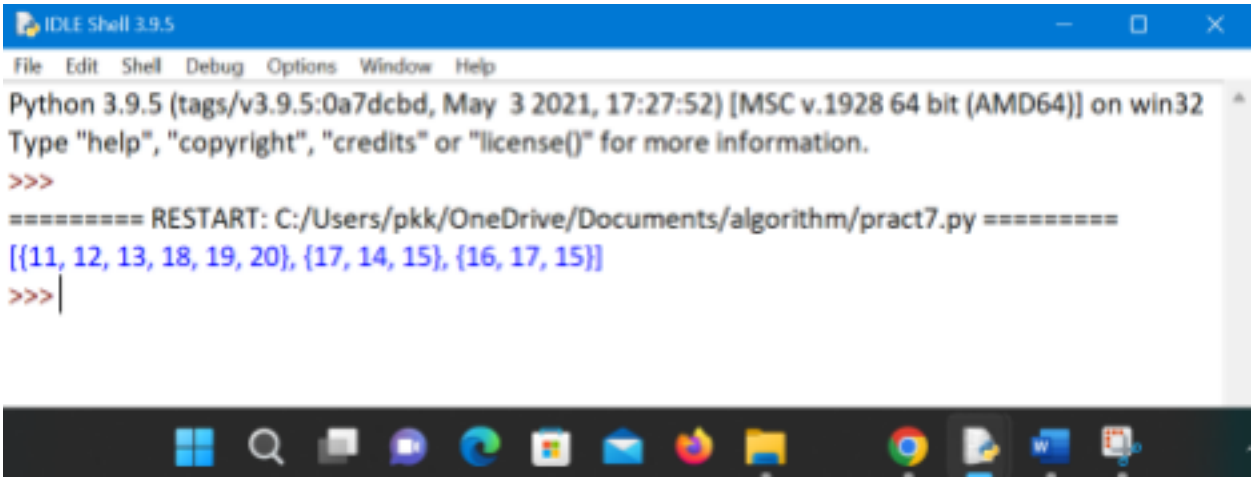


Q8) Write a program for Set Covering Problem

```
def set_cover(universe, subsets):

    """Find a family of subsets that covers the universal set"""
    elements = set(e for s in subsets for e in s)

    # Check the subsets cover the universe

    if elements != universe:
        return None

    covered = set()

    cover = []

    # Greedily add the subsets with the

    most uncovered points while covered !=

    elements:

        subset = max(subsets, key=lambda s:

        len(s - covered))

        cover.append(subset)

        covered |= subset
```

```
    return cover


def main():
    universe = set(range(11, 21))
      subsets = [set([11,12,
        13, 18, 19,20]),
      set([11, 12, 13, 14,
            15]),
        set([14,15, 17]),
        set([15, 16, 17]),
        set([16, 17, 18, 19,20])]
    cover = set_cover(universe, subsets)
    print(cover)

    if __name__ == '__main__':
    main()
```

Output :-


IDLE Shell 3.9.5
File Edit Shell Debug Options Window Help
Python 3.9.5 (tags/v3.9.5:0a7dcbd, May 3 2021, 17:27:52) [MSC v.1928 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========= RESTART: C:/Users/pkk/OneDrive/Documents/algorithm/pract7.py =========
[{11, 12, 13, 18, 19, 20}, {17, 14, 15}, {16, 17, 15}]
>>>