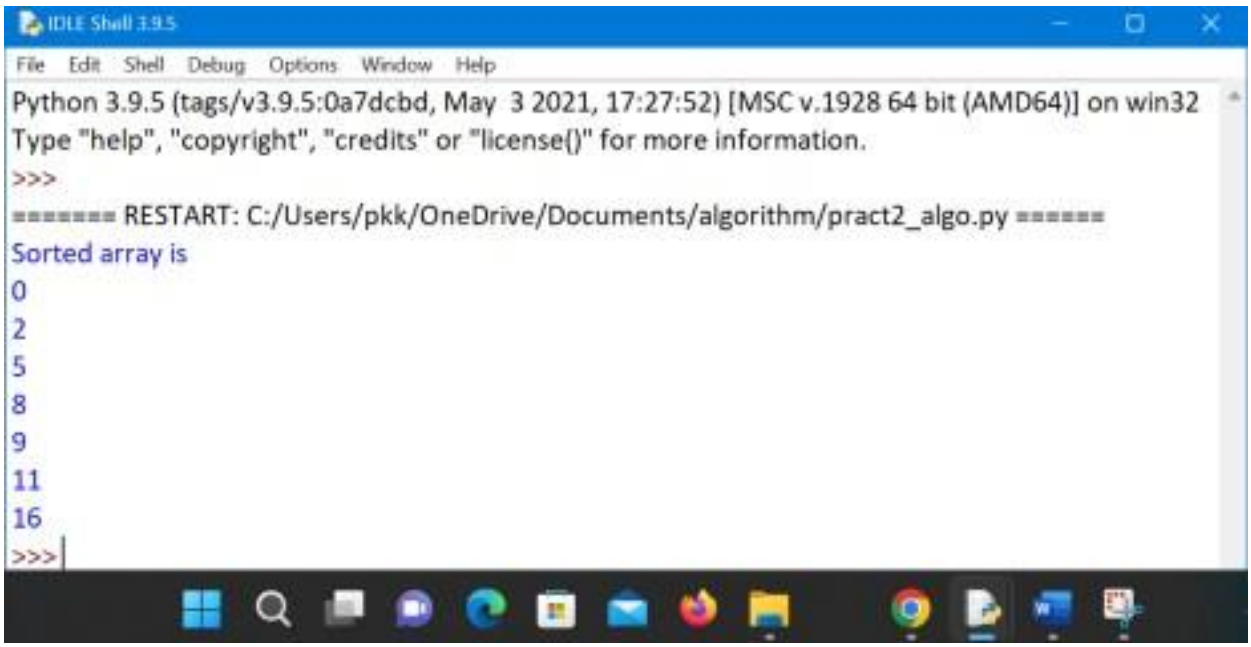
Q.1) Write a Program for Heap Sort Algorithm

```
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**

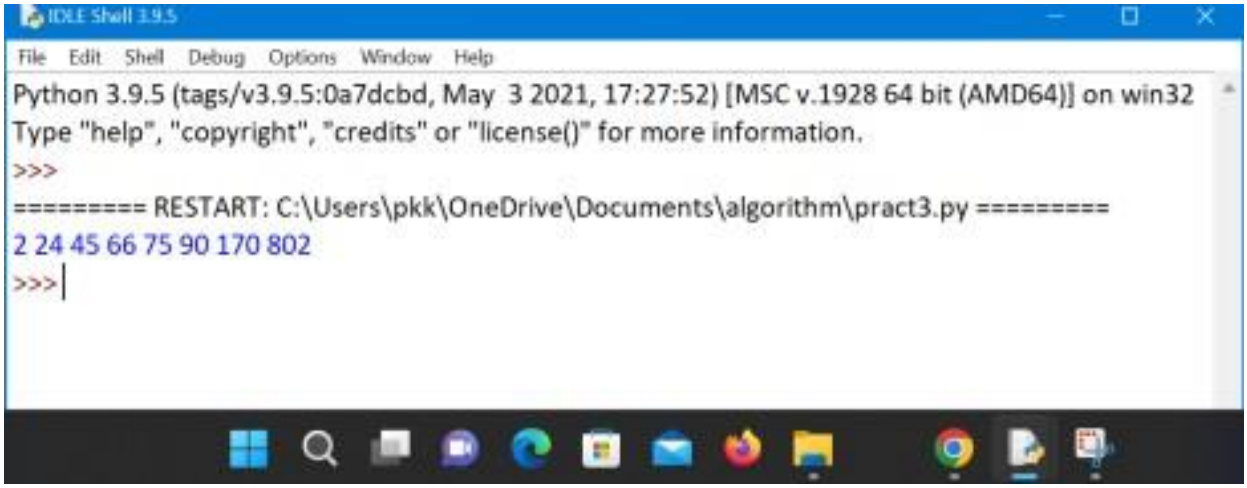


Q2) Write a Program to perform Radix Sort Algorithm

```
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=" ")
```

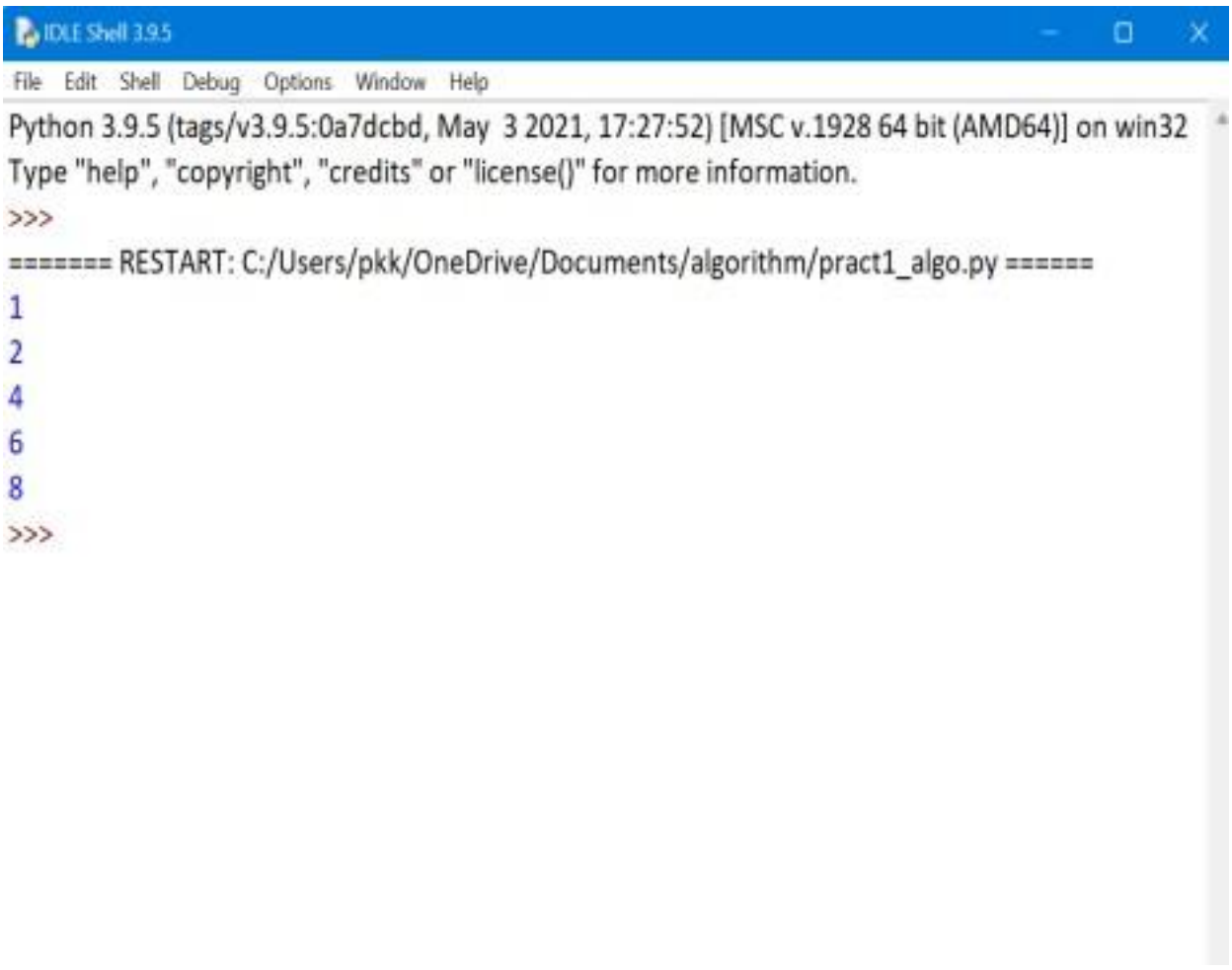


Q3) Write a Program for Randomized Selection Algorithm

```
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 :-

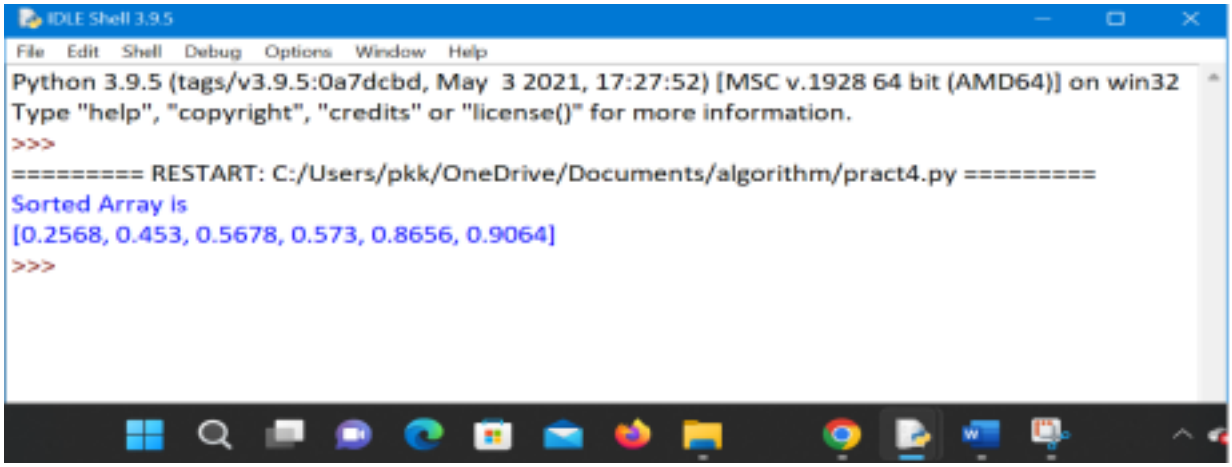


Q4) Write a Program to Perform Bucket Sort Algorithm

```
# 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 :-



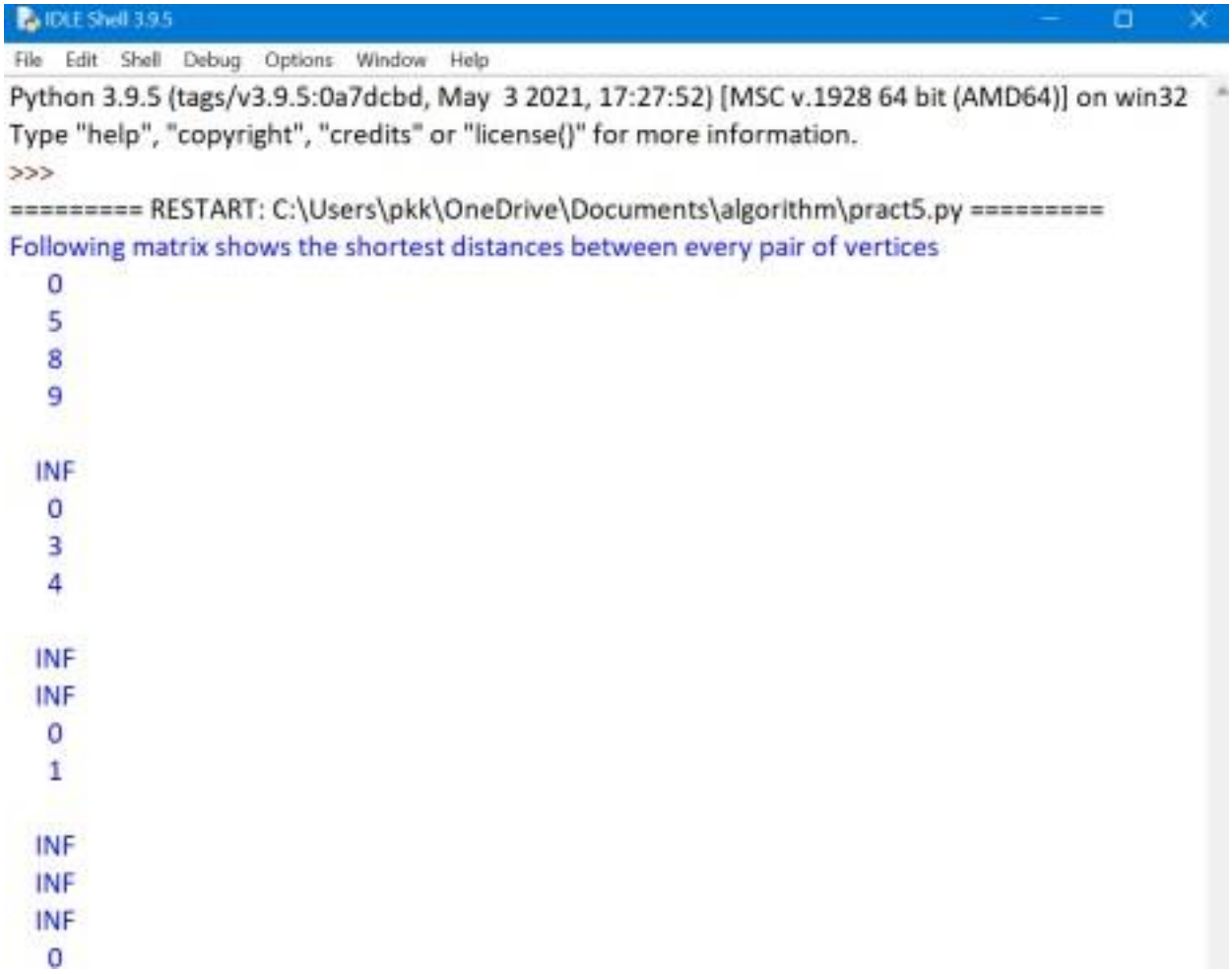
Q5) Write a Program to Perform Folyd-Warshall algorithm.

```
# 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:-

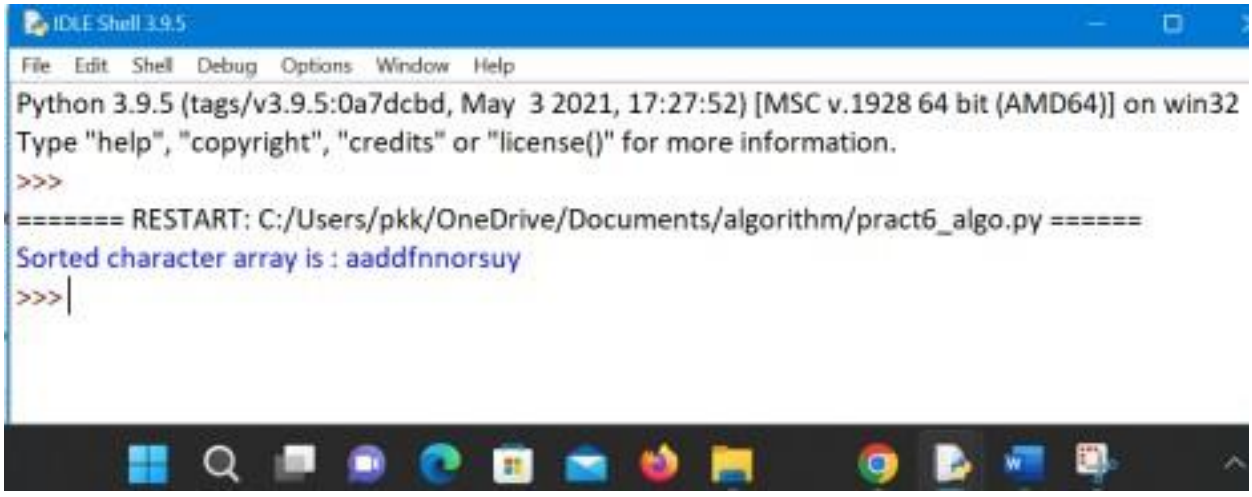


Q6) Write a Program for Counting Sort Algorithm in Python

```
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 :-

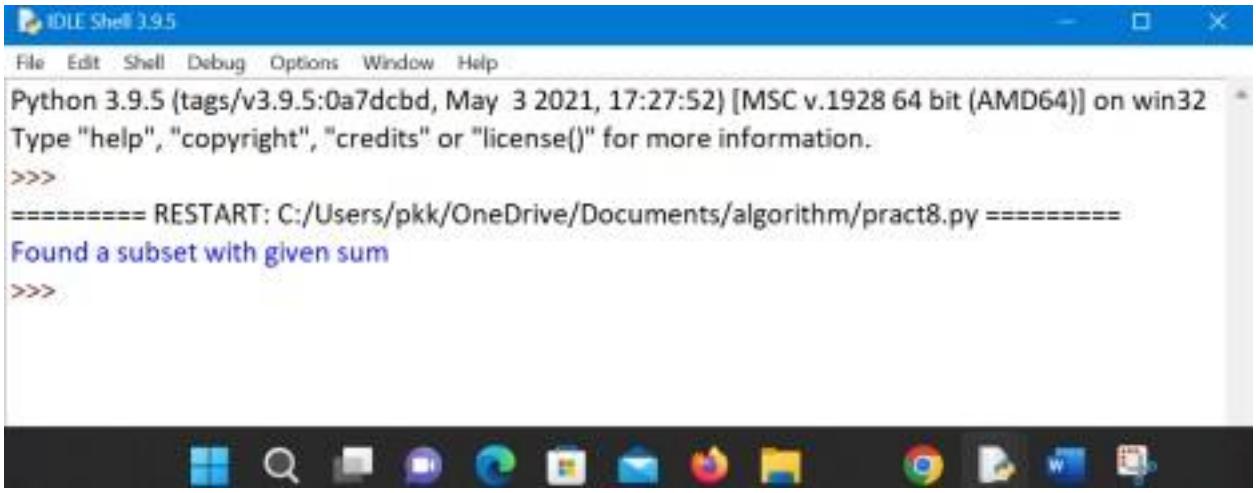


Q7) Write a Program for found a subset with given sum

```
# 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 :-