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ROLL NUMBER: 509

COURSE: MSc CS

SUBJECT: ANALYSIS OF ALGORITHM AND RESEARCH COMPUTING

PRACTICAL: 1-8

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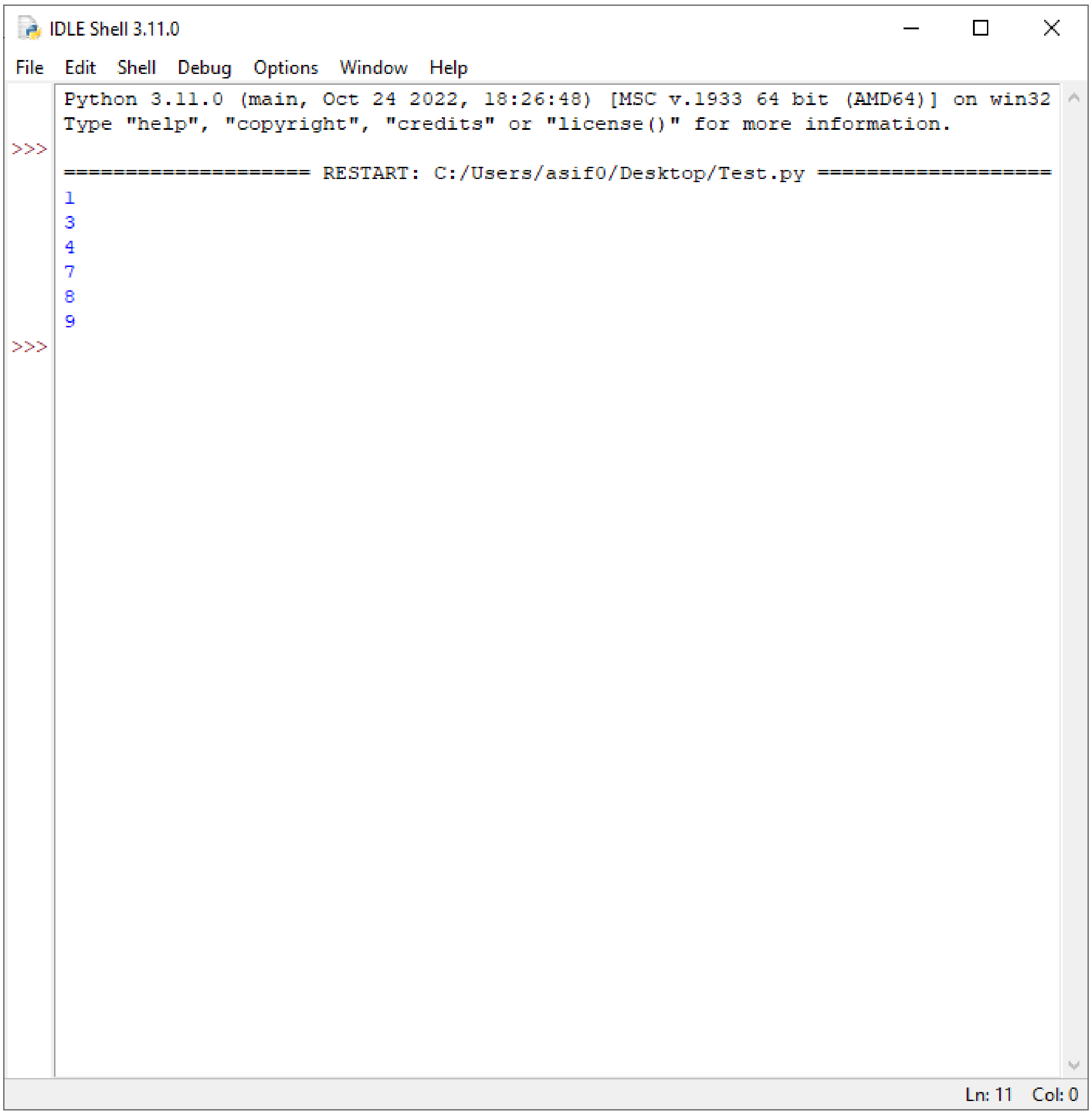
PRACTICAL 1

Q.1) 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 = [3,1,8,4,7,9]
for i in range(len(x)):
   print (RSelect(x,i)),
```

OUTPUT:



```
Python 3.11.0 (main, Oct 24 2022, 18:26:48) [MSC v.1933 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==================== RESTART: C:/Users/asif0/Desktop/Test.py ===================
1
3
4
7
8
9
>>>
```

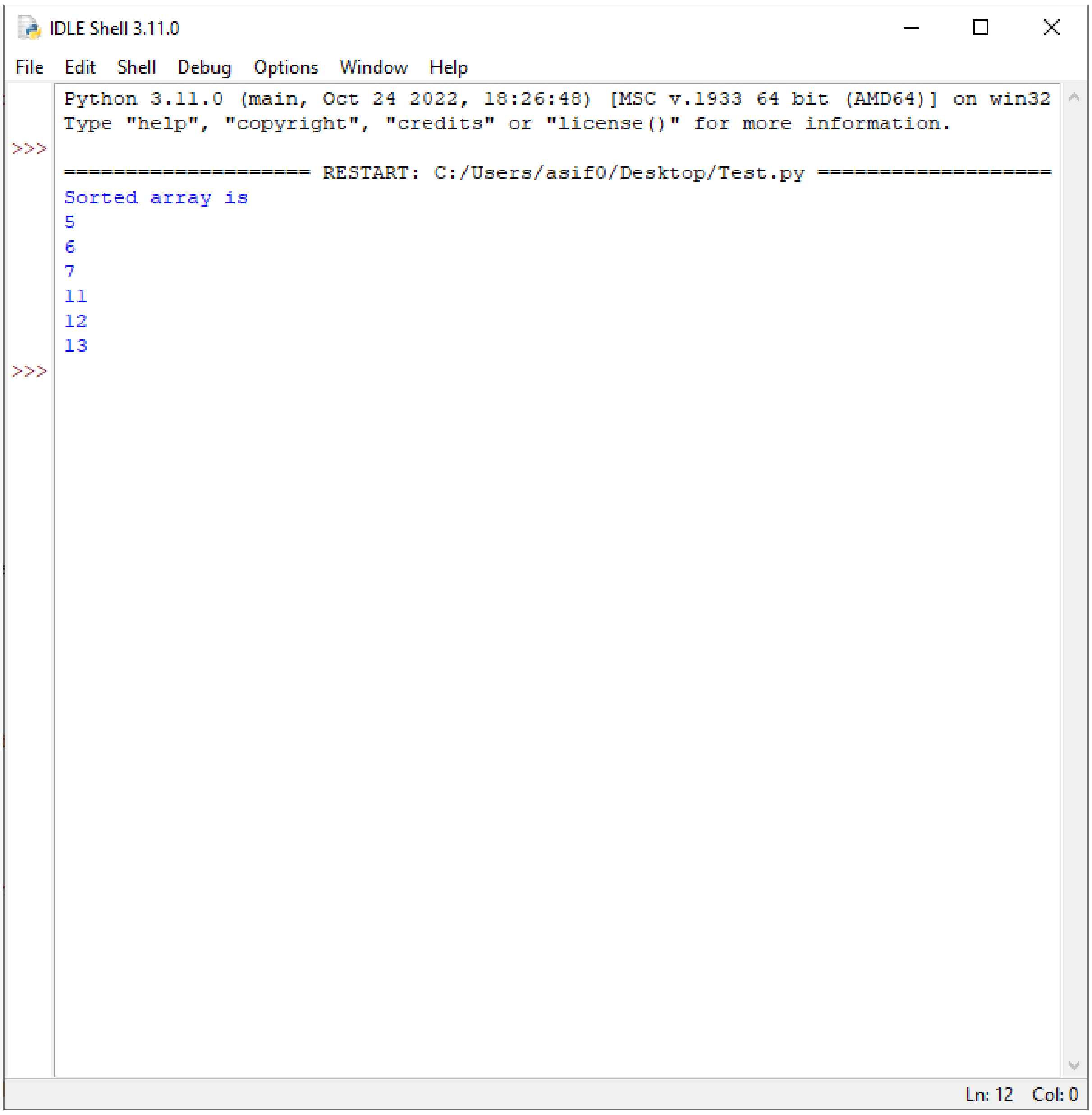
PRACTICAL 2

Q.2) Write a Program for Heap Sort Algorithm

```
# Python program for implementation of heap Sort


# 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[largest] < 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//2 - 1, -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's code
if __name__ == '__main__':
    arr = [12, 11, 13, 5, 6, 7]

    # Function call
    heapSort(arr)
    N = len(arr)

    print("Sorted array is")
```

```
for i in range(N):
    print("%d" % arr[i], end=" ")
```

OUTPUT:



```
Python 3.11.0 (main, Oct 24 2022, 18:26:48) [MSC v.1933 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==================== RESTART: C:/Users/asif0/Desktop/Test.py ===================
Sorted array is
5
6
7
11
12
13
>>>
```

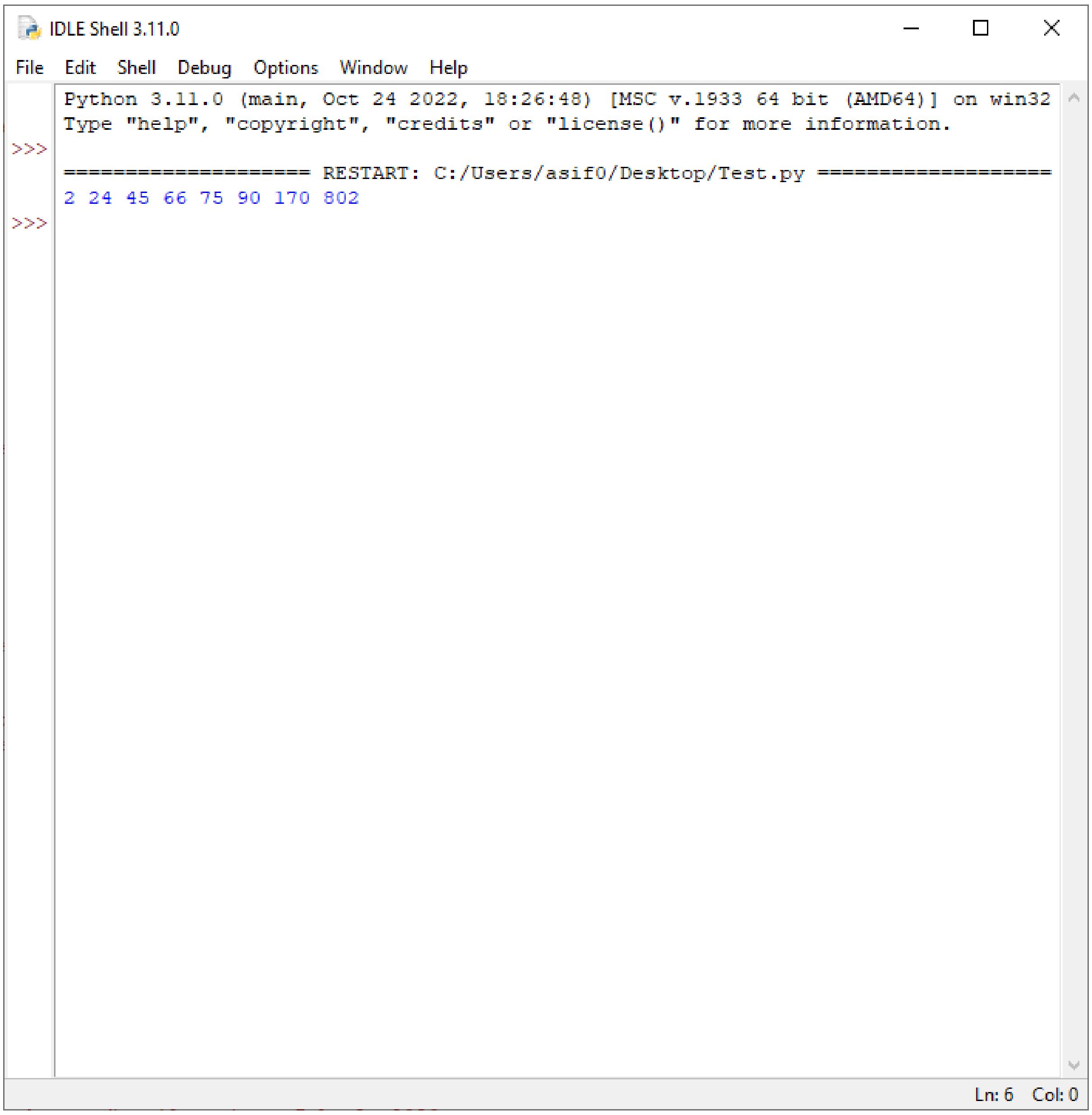
PRACTICAL 3

3) Write a Program to perform Radix Sort Algorithm

```
# 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)

    # The output array elements that will have sorted arr
    output = [0] * (n)

    # initialize count array as 0
    count = [0] * (10)

    # Store count of occurrences in count[]
    for i in range(0, n):
        index = arr[i] // exp1
        count[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[index % 10] - 1] = arr[i]
        count[index % 10] -= 1
        i -= 1

    # Copying the output array to arr[],
    # so that arr now contains sorted numbers
    i = 0
    for i in range(0, len(arr)):
        arr[i] = output[i]

# Method to do Radix Sort
def radixSort(arr):

    # Find the maximum number to know number of digits
    max1 = max(arr)

    # Do counting sort for every digit. Note that instead
    # of passing digit number, exp is passed. exp is 10^i
    # where i is current digit number
    exp = 1
    while max1 / exp >= 1:
        countingSort(arr, exp)
        exp *= 10
```

```
# Driver code
arr = [170, 45, 75, 90, 802, 24, 2, 66]


# Function Call
radixSort(arr)


for i in range(len(arr)):
    print(arr[i],end=" ")
```

OUTPUT:



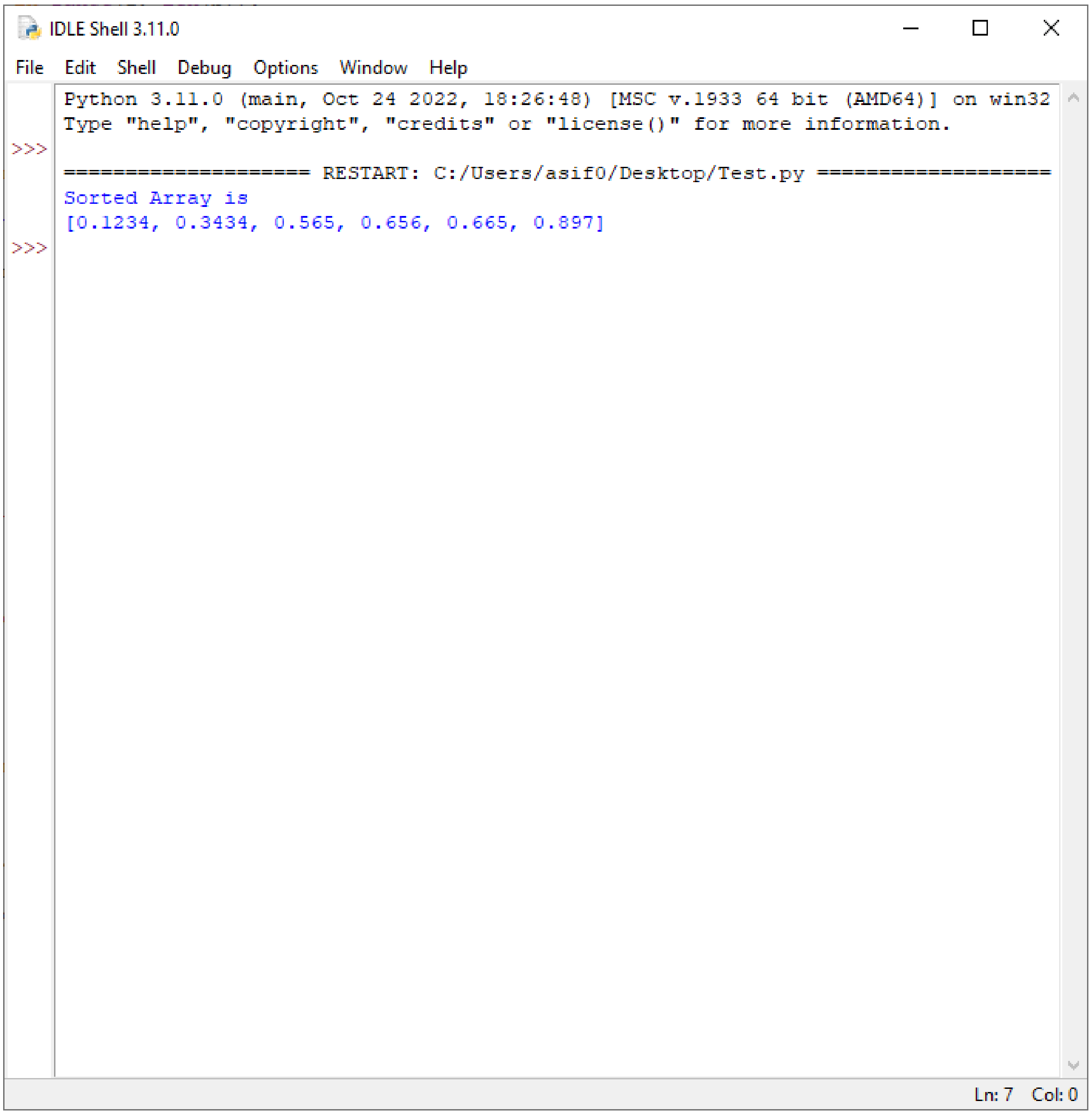
```
Python 3.11.0 (main, Oct 24 2022, 18:26:48) [MSC v.1933 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==================== RESTART: C:/Users/asif0/Desktop/Test.py ===================
2 24 45 66 75 90 170 802
>>>
```

PRACTICAL 4

4) 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 = [0.897, 0.565, 0.656,
    0.1234, 0.665, 0.3434]
print("Sorted Array is")
print(bucketSort(x))
```

OUTPUT:



```
Python 3.11.0 (main, Oct 24 2022, 18:26:48) [MSC v.1933 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==================== RESTART: C:/Users/asif0/Desktop/Test.py ===================
Sorted Array is
[0.1234, 0.3434, 0.565, 0.656, 0.665, 0.897]
>>>
```

PRACTICAL 5

5) Write a Program to Perform Folyd-Warshall algorithm

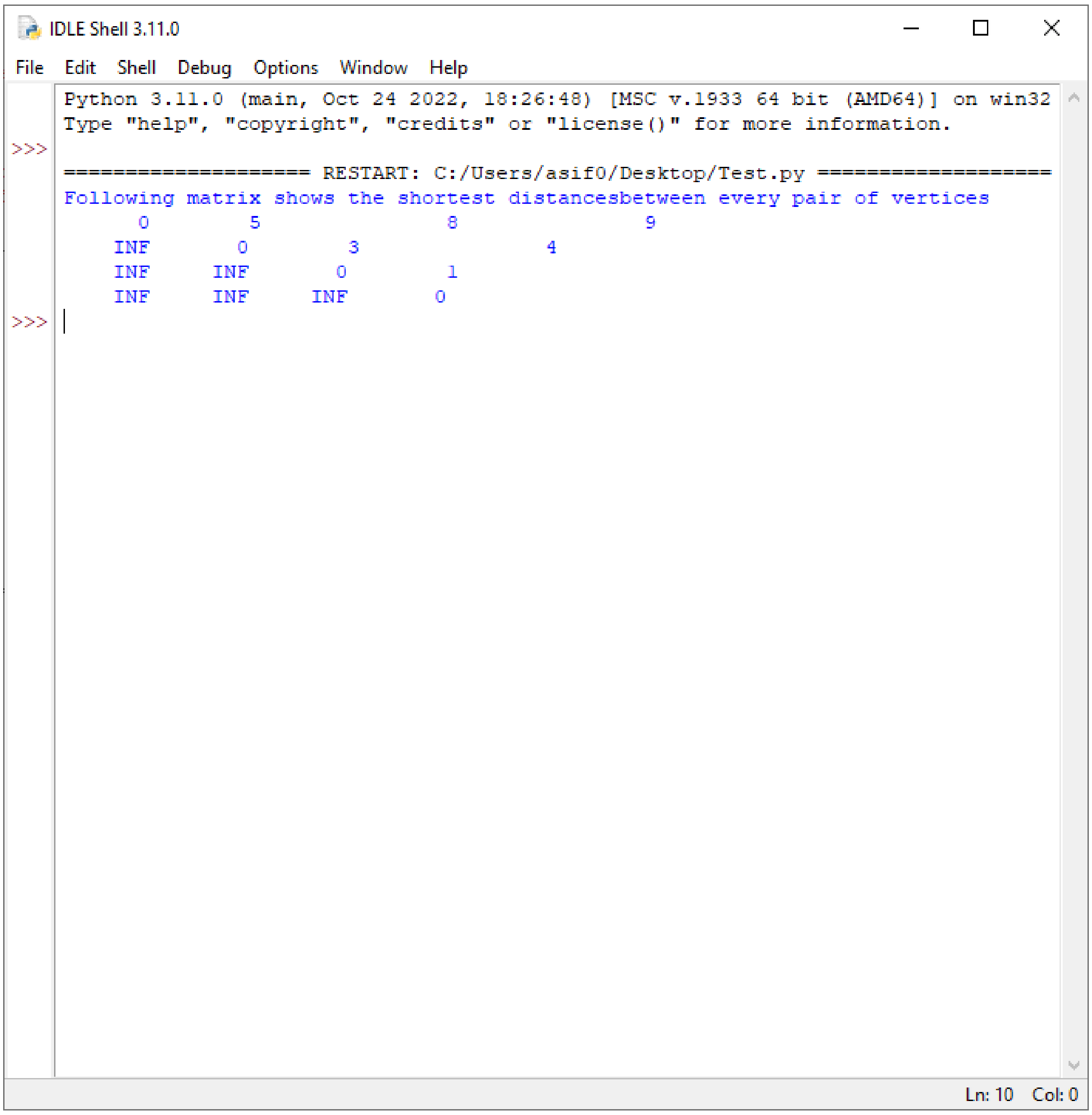
```
# Python3 Program for Floyd Warshall Algorithm


# 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[][] will be the output

    matrix that will finally

        have the shortest distances

        between every pair of vertices """

    """ initializing the solution matrix

    same as input graph matrix

    OR we can say that the initial

    values of shortest distances

    are based on shortest paths considering no
```

```
intermediate vertices """

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

""" Add all vertices one by one
to the set of intermediate
vertices.
---> Before start of an iteration,
we have shortest distances
between all pairs of vertices
such that the shortest
distances consider only the
vertices in the set
{0, 1, 2, .. k-1} as intermediate vertices.
----> After the end of a
iteration, vertex no. k is
added to the set of intermediate
vertices and the
set becomes {0, 1, 2, .. k}
"""
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"), end=" ")
            else:
                print("%7d\t" % (dist[i][j]), end=' ')
            if j == V-1:
                print()


# Driver's code
if __name__ == "__main__":
    """
```

```
          10
       (0)------->(3)
        |         /|\
      5 |          |
        |          | 1
       \|/         |
       (1)------->(2)
          3        """
graph = [[0, 5, INF, 10],
       [INF, 0, 3, INF],
       [INF, INF, 0, 1],
       [INF, INF, INF, 0]
       ]
# Function call
floydWarshall(graph)
```

OUTPUT:



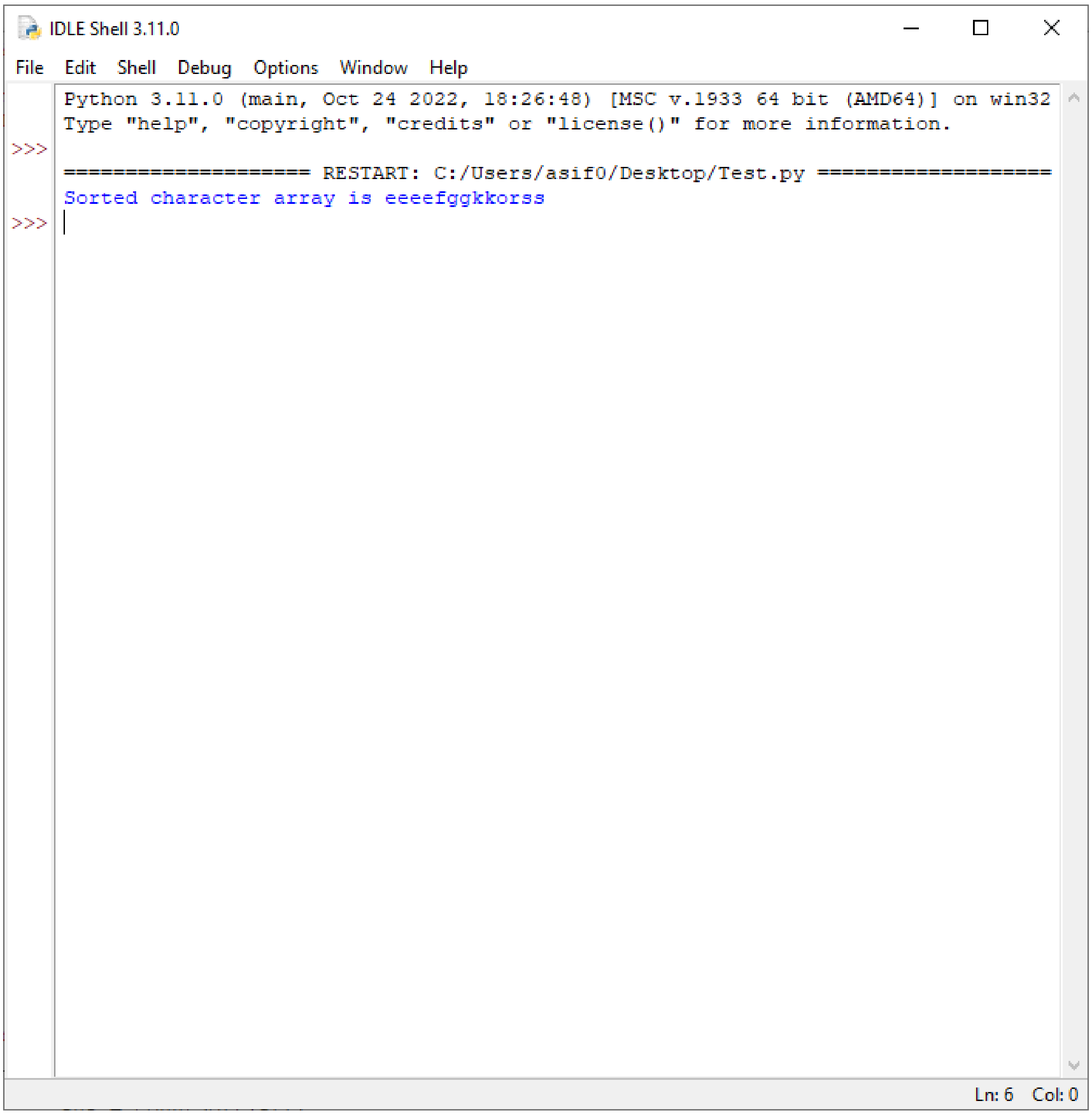
```
Python 3.11.0 (main, Oct 24 2022, 18:26:48) [MSC v.1933 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==================== RESTART: C:/Users/asif0/Desktop/Test.py ===================
Following matrix shows the shortest distancesbetween every pair of vertices
      0        5               8               9
    INF       0        3               4
    INF     INF       0        1
    INF     INF     INF       0
>>> |
```

PRACTICAL 6

6) Write a Program for Counting Sort Algorithm in python

```
# Python3 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(len(arr))]


    # Create a count array to store count of individual

    # 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 code
if __name__ == '__main__':
    arr = "geeksforgeeks"
    ans = countSort(arr)
    print("Sorted character array is % s" % ("".join(ans)))
```

OUTPUT:



```
Python 3.11.0 (main, Oct 24 2022, 18:26:48) [MSC v.1933 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==================== RESTART: C:/Users/asif0/Desktop/Test.py ===================
Sorted character array is eeeefggkkorss
>>>
```

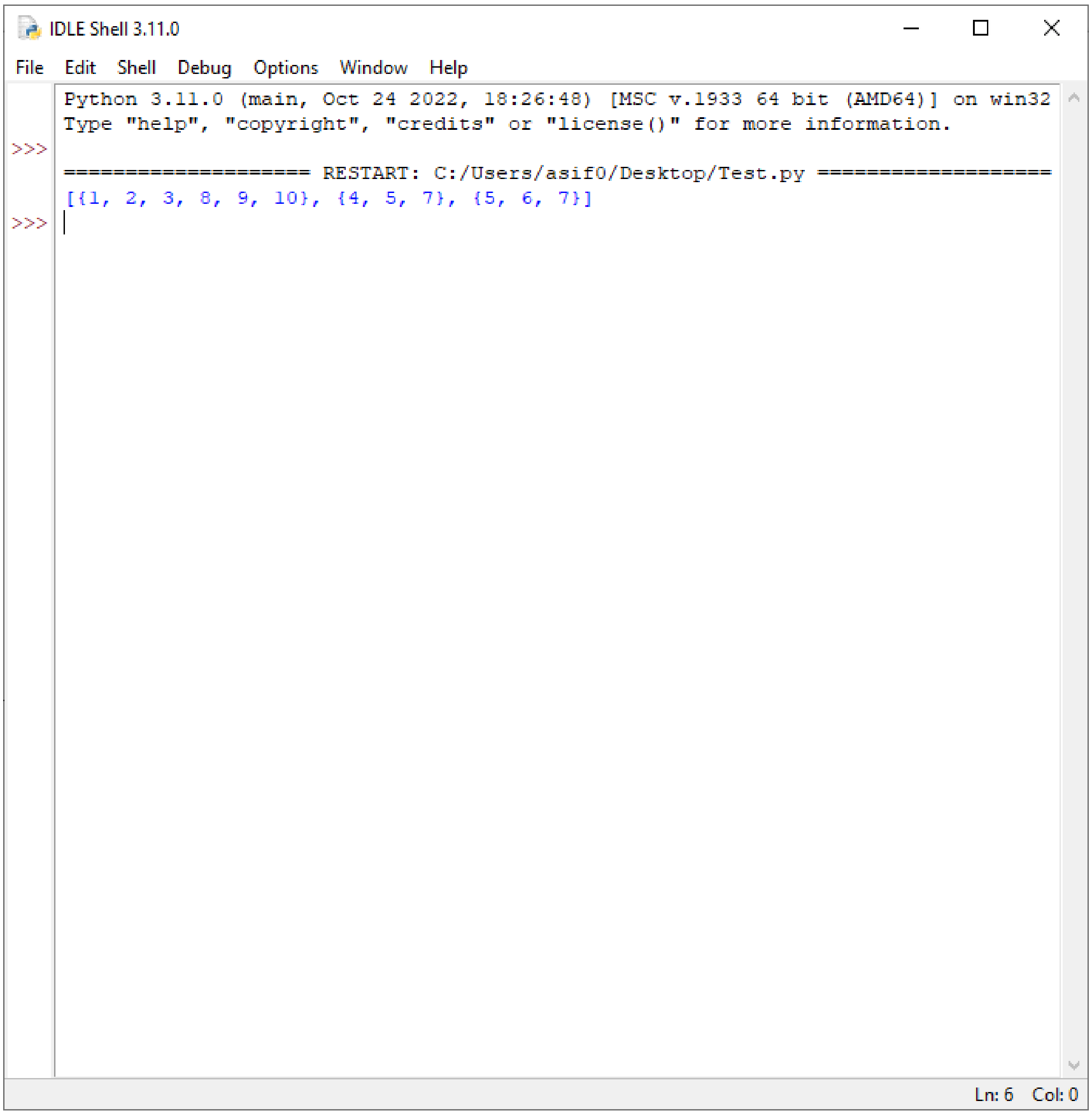
PRACTICAL 7

7) 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(1, 11))
    subsets = [set([1, 2, 3, 8, 9, 10]),
        set([1, 2, 3, 4, 5]),
        set([4, 5, 7]),
        set([5, 6, 7]),
        set([6, 7, 8, 9, 10])]
    cover = set_cover(universe, subsets)
    print(cover)


if __name__ == '__main__':
```

```
main()
```

OUTPUT:



```
Python 3.11.0 (main, Oct 24 2022, 18:26:48) [MSC v.1933 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==================== RESTART: C:/Users/asif0/Desktop/Test.py ===================
[{1, 2, 3, 8, 9, 10}, {4, 5, 7}, {5, 6, 7}]
>>>
```

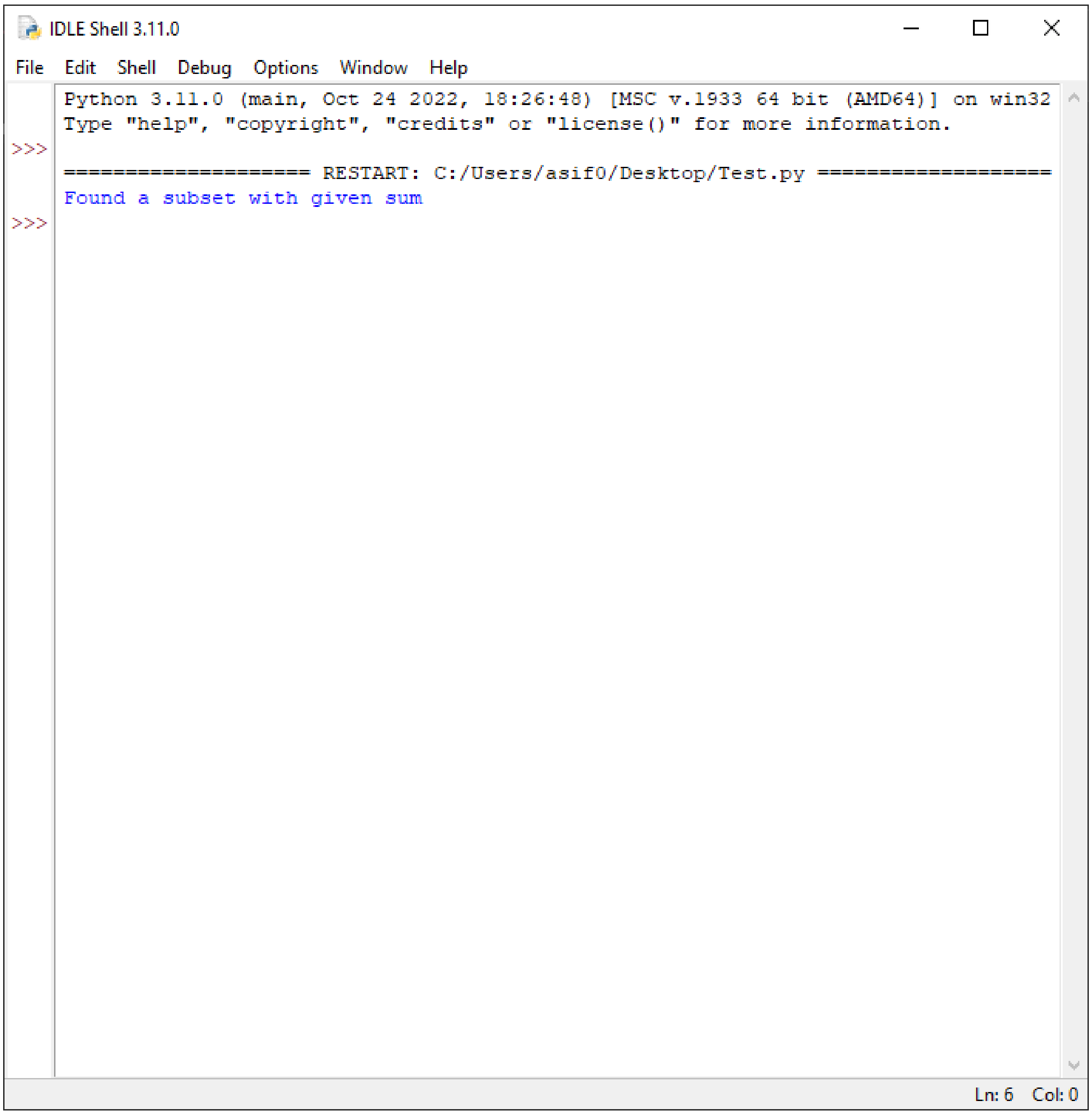
PRACTICAL 8

8) 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:



```
Python 3.11.0 (main, Oct 24 2022, 18:26:48) [MSC v.1933 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==================== RESTART: C:/Users/asif0/Desktop/Test.py ===================
Found a subset with given sum
>>>
```