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Class: MSc CS Part I **Subject:Algorithm**

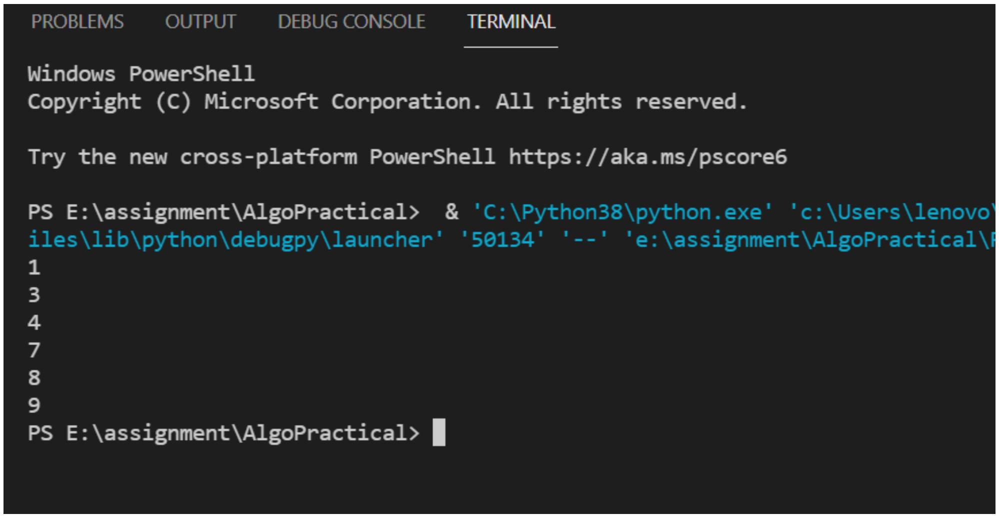
Academic Year: 2021-2022

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:



```
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PS E:\assignment\AlgoPractical>  & 'C:\Python38\python.exe' 'c:\Users\lenovo\
iles\lib\python\debugpy\launcher' '50134' '--' 'e:\assignment\AlgoPractical\P
1
3
4
7
8
9
PS E:\assignment\AlgoPractical> 
```
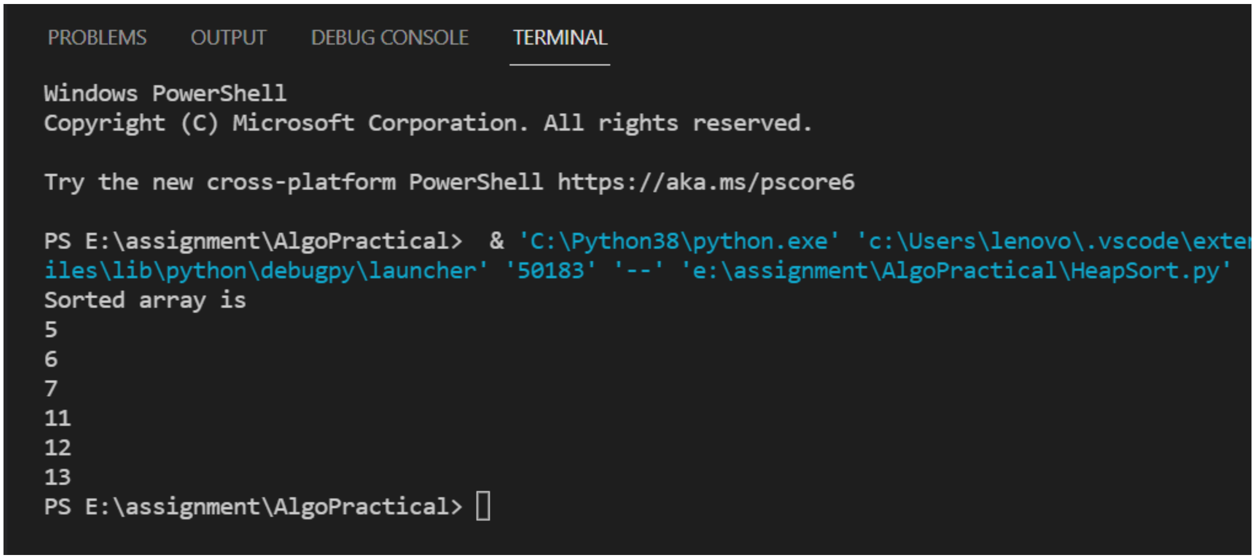

Q.2) Write a Program for Heap Sort Algorithm

```
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[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 = [ 12, 11, 13, 5, 6, 7]
heapSort(arr)
n = len(arr)
print ("Sorted array is")
for i in range(n):
    print ("%d" %arr[i]),
```

Output:



```
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PS E:\assignment\AlgoPractical>  & 'C:\Python38\python.exe' 'c:\Users\lenovo\.vscode\exte
iles\lib\python\debugpy\launcher' '50183' '--' 'e:\assignment\AlgoPractical\HeapSort.py'
Sorted array is
5
6
7
11
12
13
PS E:\assignment\AlgoPractical> 
```

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 > 0:
        countingSort(arr,exp)
        exp *= 10

# Driver code to test above
arr = [ 170, 45, 75, 90, 802, 24, 2, 66]
radixSort(arr)

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

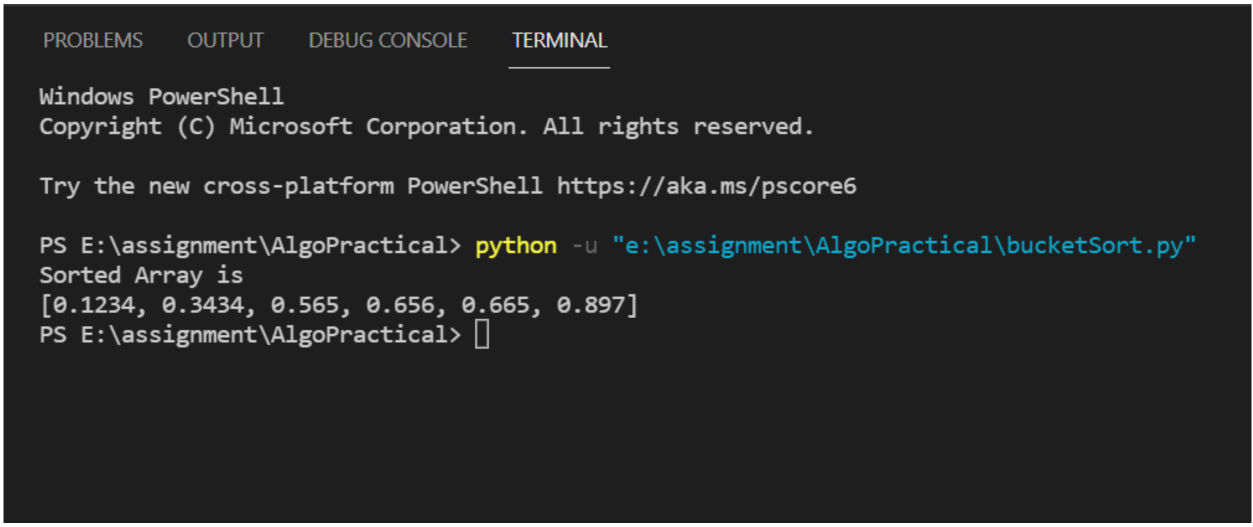
Output:

```
2 24 45 66 75 90 170 802
```

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:



```
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PS E:\assignment\AlgoPractical> python -u "e:\assignment\AlgoPractical\bucketSort.py"
Sorted Array is
[0.1234, 0.3434, 0.565, 0.656, 0.665, 0.897]
PS E:\assignment\AlgoPractical> 
```
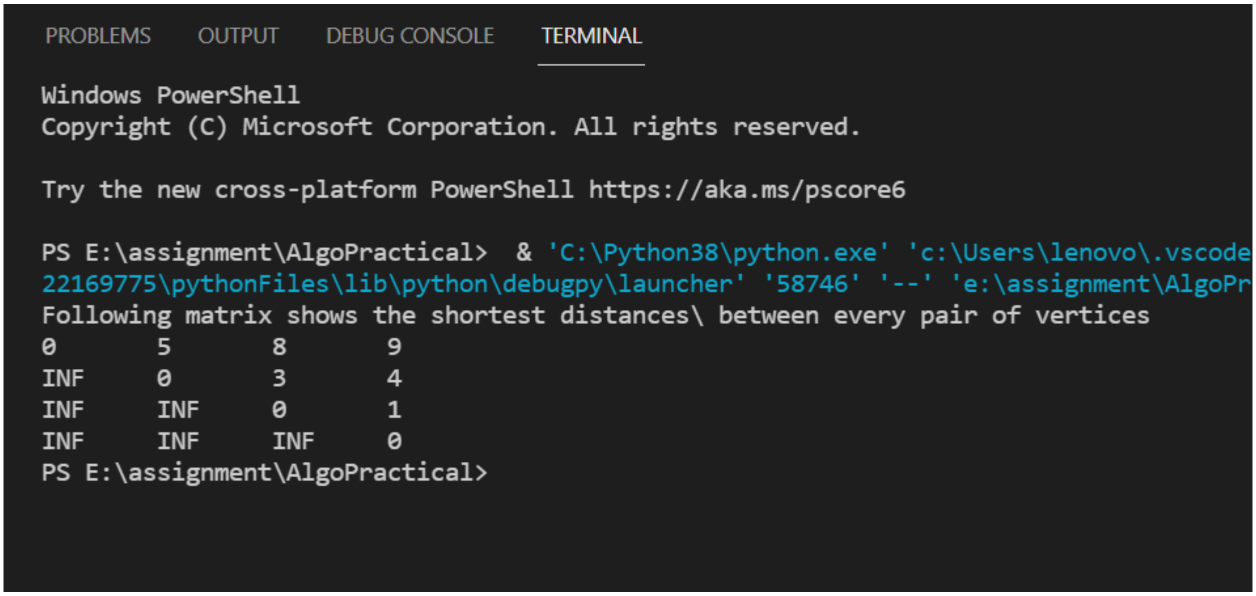

5) Write a Program to Perform Folyd-Warshall algorithm

```
# 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 = list(map(lambda i : list(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 ("INF",end="\t")
            else:
                print (dist[i][j],end="\t")
            if j == V-1:
                print (end="\n")



# Driver program to test the above program
# Let us create the following weighted graph
"""
            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]    ]
# Print the solution
floydWarshall(graph);
```

Output:



```
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PS E:\assignment\AlgoPractical>  & 'C:\Python38\python.exe' 'c:\Users\lenovo\.vscode
22169775\pythonFiles\lib\python\debugpy\launcher' '58746' '--' 'e:\assignment\AlgoPr
Following matrix shows the shortest distances\ between every pair of vertices
0       5       8       9
INF     0       3       4
INF     INF     0       1
INF     INF     INF     0
PS E:\assignment\AlgoPractical>
```
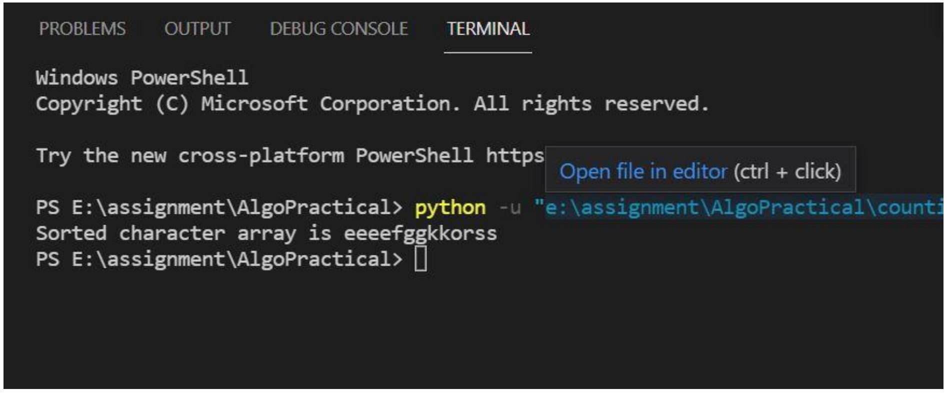

6) Write a Program for Counting Sort Algorithm in python

```
Python program for counting sort

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 = "geeksforgeeks"
ans = countSort(arr)
```

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



```
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PS E:\assignment\AlgoPractical> python -u "e:\assignment\AlgoPractical\counti
Sorted character array is eeeefggkkorss
PS E:\assignment\AlgoPractical> 
```

7) Write a program for Set Covering Problem

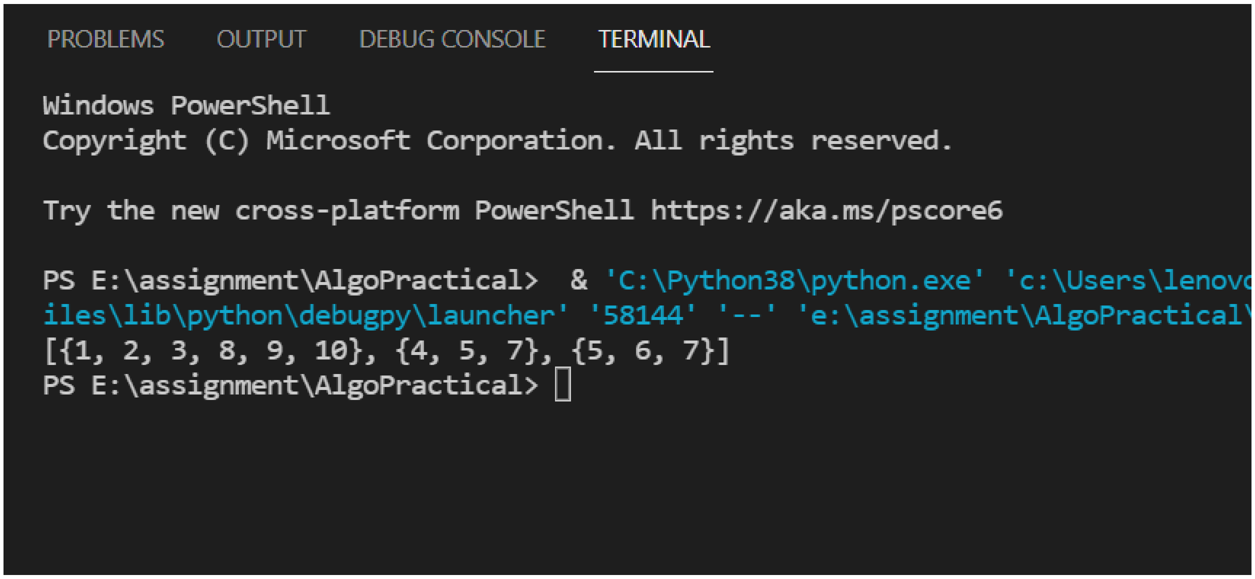
```
def set_cover(universe, subsets):
    """Find a family of subsets that covers the universal set"""
    elements = set(e for s in subsets for e in s)
    # Check the subsets cover the universe
    if elements != universe:
        return None
    covered = set()
    cover = []
    # Greedily add the 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:



```
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PS E:\assignment\AlgoPractical>  & 'C:\Python38\python.exe' 'c:\Users\lenovo
iles\lib\python\debugpy\launcher' '58144' '--' 'e:\assignment\AlgoPractical\
[{1, 2, 3, 8, 9, 10}, {4, 5, 7}, {5, 6, 7}]
PS E:\assignment\AlgoPractical> 
```
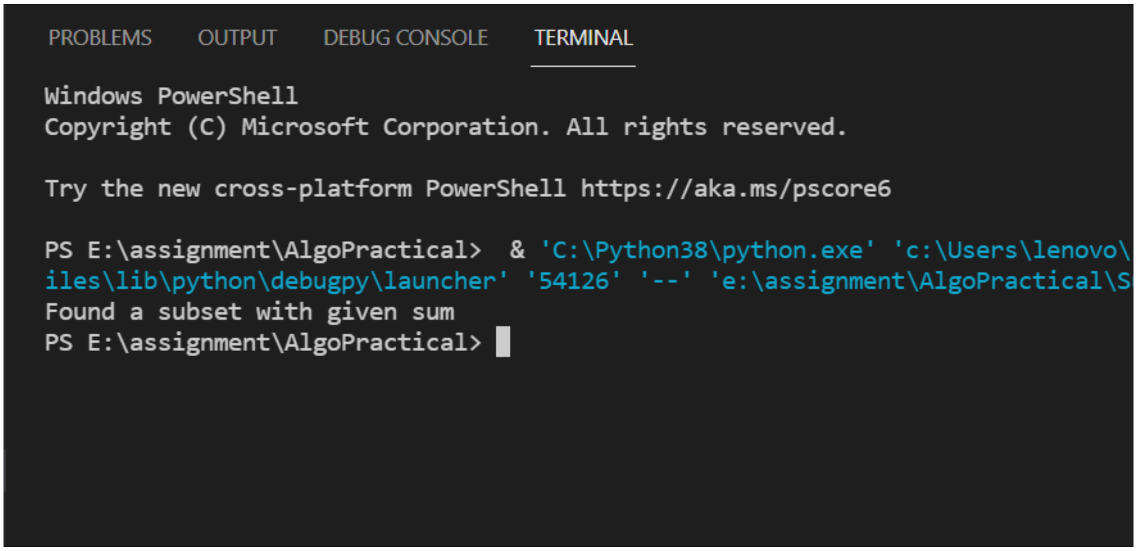

8) Write a Program for found a subset with given sum

```
# 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:



```
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PS E:\assignment\AlgoPractical>  & 'C:\Python38\python.exe' 'c:\Users\lenovo\
iles\lib\python\debugpy\launcher' '54126' '--' 'e:\assignment\AlgoPractical\S
Found a subset with given sum
PS E:\assignment\AlgoPractical>
```