

are n vertical lines drawn such that the

two endpoints of the i th line are $(i, 0)$ and $(i, \text{height}[i])$.

Find two lines that together with the x-axis form a container, such that the container contains the most water.

Return *the maximum amount of water a container can store.*

Notice that you may not slant the container.

CODE:

```
def maxArea(A, Len) : area = 0 for i in range(Len) : for j in range(i + 1, Len) : # Calculating the
max area area = max(area, min(A[j], A[i]) * (j - i)) return area # Driver code a = [ 1, 5, 4, 3 ] b = [
3, 1, 2, 4, 5 ] len1 = len(a) print(maxArea(a, len1)) len2 = len(b) print(maxArea(b, len2))
```

OUTPUT:

```

Python Shell 3.12.2
Edit Shell Debug Options Window Help
Python 3.12.2 (tags/v3.12.2:6abddd9, Feb 6 2024, 21:26:36) [MSC v.1937 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
> = RESTART: C:/Users/harik/OneDrive/Desktop/WATER TANK .PY
{1, 1}
[1, 1]
===== RESTART: C:/Users/harik/OneDrive/Desktop/WATER TANK .PY =====
6
12
|

```

12. Roman numerals are represented by seven different symbols: I, V, X, L, C, D and M.

Symbol Value

I 1

V 5

X 10

L 50

C 100

D 500

M 1000

For example, 2 is written as II in Roman numeral, just two one's added together. 12 is written as

XII, which is simply X + II. The number 27 is written as XXVII, which is XX + V + II.

Roman numerals are usually written largest to smallest from left to right. However, the numeral

for four is not IIII. Instead, the number four is written as IV. Because the one is before the five

we subtract it making four. The same principle applies to the number nine, which is written as

IX. There are six instances where subtraction is used:

I can be placed before V (5) and X (10) to make 4 and 9.

X can be placed before L (50) and C (100) to make 40 and 90.

C can be placed before D (500) and M (1000) to make 400 and 900.

Given an integer, convert it to a roman numeral.

CODE:

```
def value(r): if (r == 'I'): return 1 if (r == 'V'): return 5 if (r == 'X'): return 10 if (r == 'L'): return 50
if (r == 'C'): return 100 if (r == 'D'):
```

```

return 500
if (r == 'M'):
return 1000
return -1
def romanToDecimal(str):
res = 0
i = 0
while (i < len(str)):
# Getting value of symbol s[i]
s1 = value(str[i])
if (i + 1 < len(str)):
# Getting value of symbol s[i + 1]
s2 = value(str[i + 1])
# Comparing both values
if (s1 >= s2):
# Value of current symbol is greater
# or equal to the next symbol
res = res + s1
i = i + 1
else:
# Value of current symbol is greater
# or equal to the next symbol
res = res + s2 - s1
i = i + 2
else:
res = res + s1
i = i + 1
return res
# Driver code
print("Integer form of Roman Numeral is"),
print(romanToDecimal("MCMIV"))

```

OUTPUT:

```
Python 3.12.2 (tags/v3.12.2:6abddd9, Feb 6 2024, 21:26:36) [MSC v.1937 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.

===== RESTART: C:/Users/harik/OneDrive/Desktop/ROMAN TO DECIMAL-12 .py =====
Integer form of Roman Numeral is
1904
```

13. Roman to Integer

Roman numerals are represented by seven different symbols: I, V, X, L, C, D and M.

Symbol Value

I 1

V 5

X 10

L 50

C 100

D 500

M 1000

For example, 2 is written as II in Roman numeral, just two ones added together. 12 is written as

XII, which is simply X + II. The number 27 is written as XXVII, which is XX + V + II.

Roman numerals are usually written largest to smallest from left to right. However, the numeral

for four is not IIII. Instead, the number four is written as IV. Because the one is before the five

we subtract it making four. The same principle applies to the number nine, which is written as

IX. There are six instances where subtraction is used:

● I can be placed before V (5) and X (10) to make 4 and 9.

● X can be placed before L (50) and C (100) to make 40 and 90.

● C can be placed before D (500) and M (1000) to make 400 and 900. Code:

```
roman = {'I':1,'V':5,'X':10,'L':50,'C':100,'D':500,'M':1000}
```

```
class Solution:
```

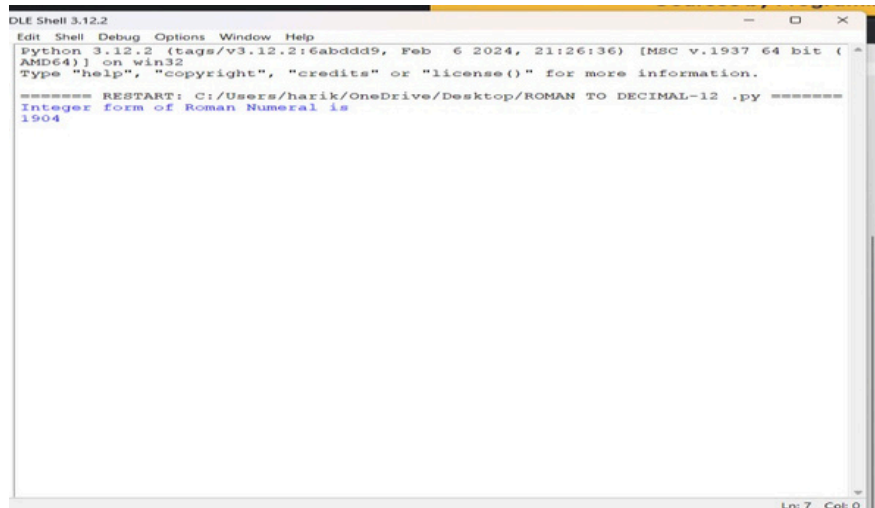
```
def romanToInt(self, S: str) -> int:
```

```
    summ= 0
```

```

for i in range(len(S)-1,-1,-1):
    num = roman[S[i]]
    if 3*num < summ:
        summ = summ-num
    else:
        summ = summ+num
return sum
OUTPUT:

```



```

DLE Shell 3.12.2
Edit Shell Debug Options Window Help
Python 3.12.2 (tags/v3.12.2:6abddd9, Feb 6 2024, 21:26:36) [MSC v.1937 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
===== RESTART: C:/Users/harik/OneDrive/Desktop/ROMAN TO DECIMAL-12 .py =====
Integer form of Roman Numeral is
1904

```

14. Longest Common Prefix

Write a function to find the longest common prefix string amongst an array of strings. If there is no common prefix, return an empty string ""

CODE:

```

def longestCommonPrefix(a):
    size = len(a)
    # if size is 0, return empty string
    if (size == 0):
        return ""
    if (size == 1):
        return a[0]
    # sort the array of strings
    a.sort()
    # find the minimum length from
    # first and last string
    end = min(len(a[0]), len(a[size - 1]))
    # find the common prefix between

```

```

# the first and last string
i = 0
while (i < end and
a[0][i] == a[size - 1][i]):
i += 1
pre = a[0][0: i]
return pre
# Driver Code
if __name__ == "__main__":
input = ["geeksforgeeks", "geeks",
"geek", "geezer"]
print("The longest Common Prefix is :",
longestCommonPrefix(inp)
OUTPUT:

```



```

DLE Shell 3.12.2
Edit Shell Debug Options Window Help
Python 3.12.2 (tags/v3.12.2:6abddd9, Feb  6 2024, 21:26:36) [MSC v.1937 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.

===== RESTART: C:/Users/harik/OneDrive/Desktop/longest prefix.py =====
The longest Common Prefix is : gee

```

15. 3Sum

Given an integer array `nums`, return all the triplets `[nums[i], nums[j], nums[k]]` such that $i \neq j$, $i \neq k$, and $j \neq k$, and $nums[i] + nums[j] + nums[k] == 0$. Notice that the solution set must not contain duplicate triplets. Example 1: Input: `nums = [-1,0,1,2,-1,-4]` Output: `[[-1,-1,2],[-1,0,1]]` Explanation: $nums[0] + nums[1] + nums[2] = (-1) + 0 + 1 = 0$. $nums[1] + nums[2] + nums[4] = 0 + 1 + (-1) = 0$. $nums[0] + nums[3] + nums[4] = (-1) + 2 + (-1) = 0$. The distinct triplets are `[-1,0,1]` and `[-1,-1,2]`. Notice that the order of the output and the order of the triplets does not matter.

CODE:

```
def findTriplets(nums, n, Sum):  
    i = 0  
    j = 0  
    k = 0  
    # list to store all unique triplets.  
    triplet = []  
    # list to store already found triplets  
    # to avoid duplication.  
    uniqTriplets = []  
    # Variable used to hold triplet  
    # converted to string form.  
    temp = ""  
    # Variable used to store current  
    # triplet which is stored in vector  
    # if it is unique.  
    newTriplet = [0, 0, 0]  
    # Sort the input array.  
    nums.sort()  
    # Iterate over the array from the  
    # start and consider it as the  
    # first element.  
    for i in range(n - 2):  
        # index of the first element in  
        # the remaining elements.  
        j = i + 1  
        # index of the last element.  
        k = n - 1  
  
        while(j < k):  
  
            # If sum of triplet is equal to
```

```

# given value, then check if
# this triplet is unique or not.
# To check uniqueness, convert
# triplet to string form and
# then check if this string is
# present in set or not. If
# triplet is unique, then store
# it in list.
if(nums[i] + nums[j] + nums[k] == Sum):
    temp = str(nums[i]) + ":" + str(nums[j]) + ":" + str(nums[k])
    if temp not in uniqTriplets:
        uniqTriplets.append(temp)
        newTriplet[0] = nums[i]
        newTriplet[1] = nums[j]
        newTriplet[2] = nums[k]
        triplet.append(newTriplet)
        newTriplet = [0, 0, 0]

# Increment the first index
# and decrement the last
# index of remaining elements.
j += 1
k -= 1

# If sum is greater than given
# value then to reduce sum
# decrement the last index.
elif(nums[i] + nums[j] + nums[k] > Sum):
    k -= 1

# If sum is less than given value
# then to increase sum increment

```

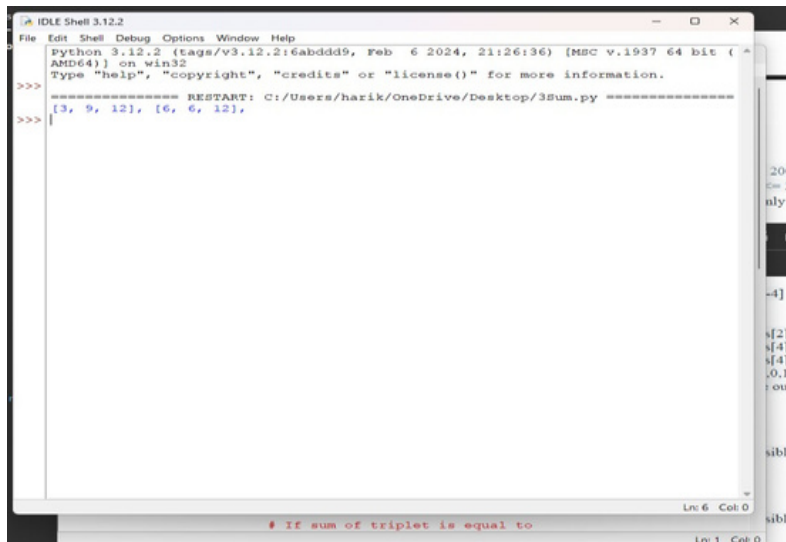


```
# the first index of remaining
# elements.
else:
    j += 1
# If no unique triplet is found, then
# return 0.
if(len(triplet) == 0):
    return 0
```

```
# Print all unique triplets stored in
# list.
for i in range(len(triplet)):
    print(triplet[i], end = ", ")
return 1
```

```
# Driver Code
nums = [12, 3, 6, 1, 6, 9]
n = len(nums)
Sum = 24
```

```
# Function call
if(not findTriplets(nums, n, Sum)):
    print("No triplets can be formed.")
output:
```



16. 3Sum Closest

Given an integer array `nums` of length `n` and an integer `target`, find three integers in `nums` such

that the sum is closest to `target`.

Return *the sum of the three integers*.

You may assume that each input would have exactly one solution.

CODE:

```
import sys
```

```
# Function to return the sum of a
```

```
# triplet which is closest to x
```

```
def solution(arr, x):
```

```
# To store the closest sum
```

```
closestSum = sys.maxsize
```

```
# Run three nested loops each loop
```

```
# for each element of triplet
```

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

```
for j in range(i + 1, len(arr)):
```

```
for k in range(j + 1, len( arr)):
```

```
# Update the closestSum
```

```

if(abs(x - closestSum) >
abs(x - (arr[i] +
arr[j] + arr[k]))):
closestSum = (arr[i] +
arr[j] + arr[k])

# Return the closest sum found
return closestSum

```

```

# Driver code
if __name__ == "__main__":

```

```

arr = [ -1, 2, 1, -4 ]
x = 1

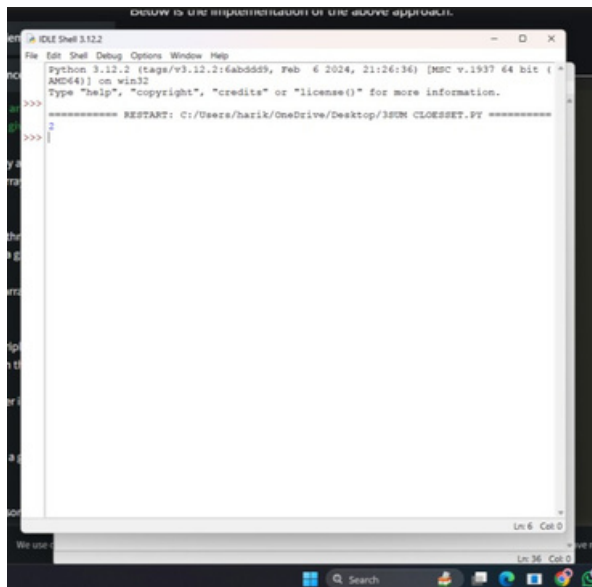
```

```

print(solution(arr, x))

```

output:



17. Letter Combinations of a Phone Number

Given a string containing digits from 2-9 inclusive, return all possible letter combinations that the number could represent. Return the answer in any order.

A mapping of digits to letters (just like on the telephone buttons) is given below. Note that 1 does not map to any letters.

CODE:

Python3 implementation of the approach

from collections import deque

Function to return a list that contains

all the generated letter combinations

def letterCombinationsUtil(number, n, table):

list = []

q = deque()

q.append("")

while len(q) != 0:

 s = q.pop()

 # If complete word is generated

 # push it in the list

 if len(s) == n:

 list.append(s)

 else:

 # Try all possible letters for current digit

 # in number[]

 for letter in table[number[len(s)]]:

 q.append(s + letter)

Return the generated list

return list

```

# Function that creates the mapping and
# calls letterCombinationsUtil
def letterCombinations(number, n):

    # table[i] stores all characters that
    # corresponds to ith digit in phone
    table = ["0", "1", "abc", "def", "ghi", "jkl",
            "mno", "pqrs", "tuv", "wxyz"]

    list = letterCombinationsUtil(number, n, table)

    s = ""
    for word in list:
        s += word + " "

    print(s)
    return

# Driver code
number = [2, 3]
n = len(number)

# Function call
letterCombinations(number, n)

```

OUTPUT:



18. 4Sum

Given an array `nums` of `n` integers, return *an array of all the unique quadruplets* `[nums[a], nums[b], nums[c], nums[d]]` such that:

- $0 \leq a, b, c, d < n$
- `a`, `b`, `c`, and `d` are distinct.
- `nums[a] + nums[b] + nums[c] + nums[d] == target`

CODE:

Store the pair of indices

class Pair:

def __init__(self, x, y):

self.index1 = x

self.index2 = y

Function to find the all the unique quadruplets

with the elements at different indices

def GetQuadruplets(nums, target):

Store the sum mapped to a list of pair indices

map = {}

Generate all possible pairs for the map

for i in range(len(nums) - 1):

```

for j in range(i + 1, len(nums)):
    # Find the sum of pairs of elements
    sum = nums[i] + nums[j]

    # If the sum doesn't exist then update with the new pairs
    if sum not in map:
        map[sum] = [Pair(i, j)]
    # Otherwise, add the new pair of indices to the current sum
    else:
        map[sum].append(Pair(i, j))

# Store all the Quadruplets
ans = set()

for i in range(len(nums) - 1):
    for j in range(i + 1, len(nums)):
        lookUp = target - (nums[i] + nums[j])

        # If the sum with value (K - sum) exists
        if lookUp in map:
            # Get the pair of indices of sum
            temp = map[lookUp]

            for pair in temp:
                # Check if i, j, k and l are distinct or not
                if pair.index1 != i and pair.index1 != j and pair.index2 != i and pair.index2 != j:
                    l1 = [nums[pair.index1], nums[pair.index2], nums[i], nums[j]]

            # Sort the list to avoid duplicacy
            l1.sort()

            # Update the set

```

```
ans.add(tuple(l1))
```

```
# Print all the Quadruplets
```

```
print(*reversed(list(ans)), sep = '\n')
```

```
# Driver Code
```

```
arr = [1, 0, -1, 0, -2, 2]
```

```
K = 0
```

```
GetQuadruplets(arr, K)
```

OUTPUT:



```
File Edit Shell Debug Options Window Help
Python 3.12.2 (tags/v3.12.2:6abddd9, Feb  6 2024, 21:26:36) [MSC v.1937 64 bit (
AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:/Users/harik/OneDrive/Desktop/3SUM CLOSET.PY =====
>>> 2
===== RESTART: C:/Users/harik/OneDrive/Desktop/17.PY =====
>>> cf ce cd bf be bd af ae ad
===== RESTART: C:/Users/harik/AppData/Local/Programs/Python/Python312/10.PY =====
>>> (-2, 0, 0, 2)
>>> (-1, 0, 0, 1)
>>> (-2, -1, 1, 2)
>>> |
```

19. Remove Nth Node From End of List

Given the head of a linked list, remove the nth node from the end of the list and return its head.

CODE:

```
# Python code for the deleting a node from end
```

```
# in two traversal
```

```
class Node:
```

```
    def __init__(self, value):
```

```
        self.data = value
```

```
        self.next = None
```



```
def length(head):  
    temp = head  
    count = 0  
    while(temp != None):  
        count += 1  
        temp = temp.next  
    return count
```

```
def printList(head):  
    ptr = head  
    while(ptr != None):  
        print (ptr.data, end = " ")  
        ptr = ptr.next  
    print()
```

```
def deleteNthNodeFromEnd(head, n):  
    Length = length(head)  
    nodeFromBeginning = Length - n + 1  
    prev = None  
    temp = head  
    for i in range(1, nodeFromBeginning):  
        prev = temp  
        temp = temp.next  
    if(prev == None):  
        head = head.next  
    return head  
else:  
    prev.next = prev.next.next  
    return head
```

```
if __name__ == '__main__':
```

```

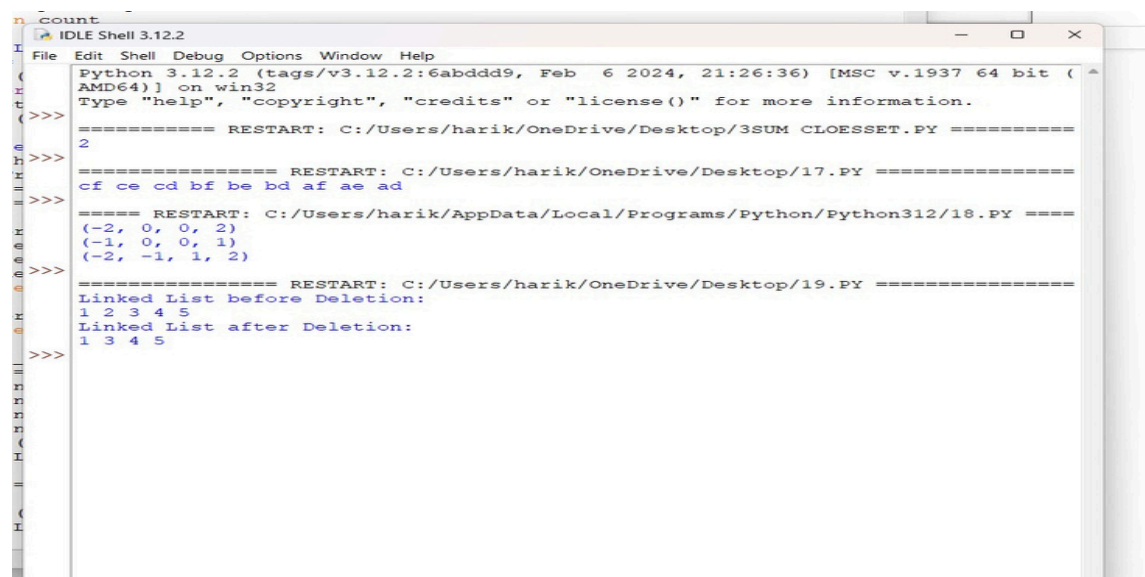
head = Node(1)
head.next = Node(2)
head.next.next = Node(3)
head.next.next.next = Node(4)
head.next.next.next.next = Node(5)
print("Linked List before Deletion:")
printList(head)

head = deleteNthNodeFromEnd(head, 4)

print("Linked List after Deletion:")
printList(head)

```

OUTPUT:



```

Python 3.12.2 (tags/v3.12.2:6abddd9, Feb 6 2024, 21:26:36) [MSC v.1937 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:/Users/harik/OneDrive/Desktop/3SUM CLOESSET.PY =====
2
>>>
===== RESTART: C:/Users/harik/OneDrive/Desktop/17.PY =====
cf ce cd bf be bd af ae ad
>>>
===== RESTART: C:/Users/harik/AppData/Local/Programs/Python/Python312/18.PY =====
(-2, 0, 0, 2)
(-1, 0, 0, 1)
(-2, -1, 1, 2)
>>>
===== RESTART: C:/Users/harik/OneDrive/Desktop/19.PY =====
Linked List before Deletion:
1 2 3 4 5
Linked List after Deletion:
1 3 4 5
>>>

```

20. Valid Parentheses

Given a string *s* containing just the characters '(', ')', '{', '}', '[' and ']', determine if the input string is valid.

An input string is valid if:

1. Open brackets must be closed by the same type of brackets.

- 2 .Open brackets must be closed in the correct order.
- 3 .Every close bracket has a corresponding open bracket of the same type.

```
CODE: def areBracketsBalanced(expr):
stack = [] # Traversing the Expression for
char in expr: if char in ["(", "{", "["]: #
Push the element in the stack
stack.append(char) else: # IF current
character is not opening # bracket, then
it must be closing. # So stack cannot be
empty at this point. if not stack: return
False current_char = stack.pop() if
current_char == '(': if char != ")": return
False if current_char == '{': if char != "}":
return False if current_char == '[': if char
!= "]": return False # Check Empty Stack
if stack: return False return True # Driver
Code
```

```
if __name__ == "__main__":
```

```
    expr = "{}{}"
```

```
    # Function call
```

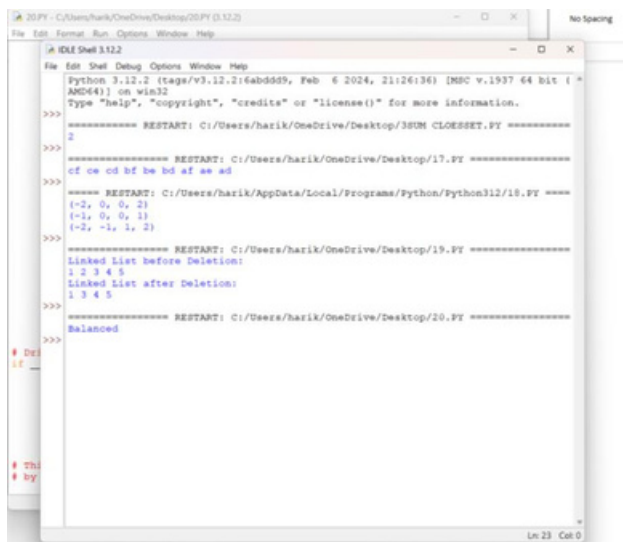
```
    if areBracketsBalanced(expr):
```

```
        print("Balanced")
```

```
    else:
```

```
        print("Not Balanced")
```

OUTPUT:



```
Python 3.12.2 (tags/v3.12.2:16abddd9, Feb 6 2024, 21:26:36) [MSC v.1937 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:/Users/harik/OneDrive/Desktop/38UM CLOSETSET.PY =====
2
>>>
===== RESTART: C:/Users/harik/OneDrive/Desktop/17.PY =====
cf ce cd bf be bd af ae ad
>>>
===== RESTART: C:/Users/harik/AppData/Local/Programs/Python/Python312/18.PY =====
(-2, 0, 0, 2)
[1, 0, 0, 1]
(-2, -1, 1, 2)
>>>
===== RESTART: C:/Users/harik/OneDrive/Desktop/19.PY =====
Linked List before Deletion:
1 2 3 4 5
Linked List after Deletion:
1 3 4 5
>>>
===== RESTART: C:/Users/harik/OneDrive/Desktop/20.PY =====
Balanced
>>>
```