```
        struct node* right;
}
```

Do not alter the structure of the tree (Should use only one tree). If there are n nodes in the tree, your function must run in O(n) time. Your program should include the following functions.

isAVL(struct node* *root*) : returns 1 if the tree is an AVL tree otherwise 0.

Input format:
A single line containing a string representing parenthesized representation of a tree.

Output Format:
Print 1 if the tree is AVL tree otherwise 0

Sample Input and Output

Input1:
(10 (15 ( ) ( )) (20 ( ) ( )))
Output1:
0

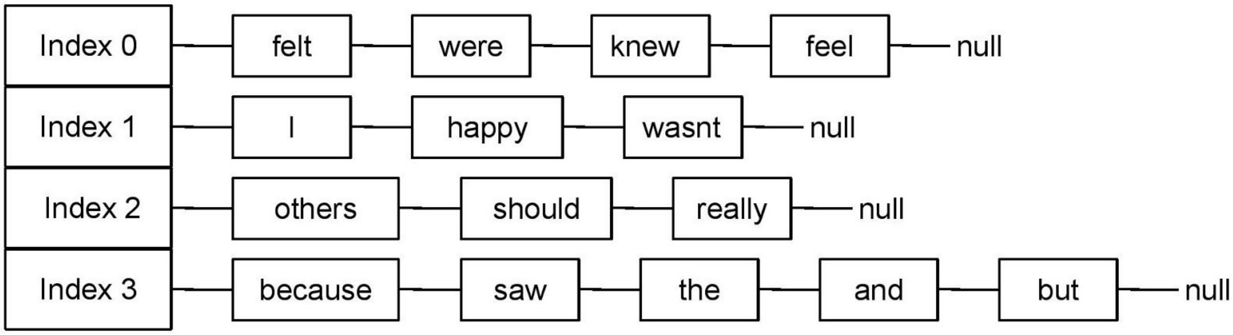
Input2:
(12 (8 (5 (4 ( ) ( )) ( )) (11 ( ) ( ))) (18 (17 ( ) ( )) ( )))
Output2:
1

3. Write a program to group the words (ignore non-alphabetic characters) according to their lengths from a given sentence (maximum of 500 characters) and a given capacity using Hashtable with separate chaining.

Example:

Given the capacity: 4
Given a sentence: I felt happy because I saw the others were happy and because I knew I should feel happy, but I wasn’t really happy.

Hashtable of the sentence:



Note: Hash table is implemented as an array in which each entry contains a head pointer to a linkedlist which contains the words of the same group. Words can be grouped using the following formula.
Index number = length of a word % capacity

Words generating same index number belong to the same linked list. Duplicate words are not allowed in the list. Each node of the linkedlist is of the following type.

```
 struct node{
char *word;     // word to be store
struct node * next;      //pointer to the next node
 }
```

Input format:
First line contains a single integer representing the capacity of the hash table.
Next line contains a stream of strings separated by spaces representing the sentence.

Output format:
Print all the lists starting from index 0, then index 1 and so on, separated by newlines.
Words on each list is separated by a single space. Print ‘NULL’ if any of the list is empty

Program includes following functions:

hashCode(char[] ***word)***: returns the index number of the word using the above mentioned formula.

groupWords(char ***sentence[]*****, int** ***capacity*****):** creates the hashtable and prints all the list.

main(): reads the inputs and calls groupWords().

Sample input and Output

Input 1:

```
4
I felt happy because I saw the others were happy and because I knew I should feel happy, but I
wasn’t really happy.
```

Output 1:

```
felt were new feel
I happy wasnt
Others should really
because saw the and but
```

Input 2:

```
10
So I said yes to Thomas Clinton and later thought that I had said yes to God and later still
realized I had said yes only to Thomas Clinton.
```

Output 2:

```
NULL
I
So to
yes and had God
said that only
later still
Thomas
Clinton thought
realized
NULL
```

4. A Needle in the Haystack

Our hacker, Little Stuart lately has been fascinated by ancient puzzles. One day going through some really old books he finds something scribbled on the corner of a page. Now Little Stuart believes that the scribbled text is more mysterious than it originally looks, so he decides to find every occurrence of all the permutations of the scribbled text in the entire book. Since this is a huge task, Little Stuart needs your help, he needs you to only figure out if any permutation of the scribbled text exists in the given text string, so he can save time and analyze only those text strings where a valid permutation is present (Use hashtable for writing your program).

Input Format:

First line contains the number of test cases T. Each test case contains two lines ,first line contains pattern and next line contains a text string. All characters in both the strings are in lowercase only [a-z].

Output Format:

For each test case print "YES" or "NO" (quotes is used only for clarity) depending on whether any permutation of the pattern exists in the text string.

Constraints:

1 ≤ T ≤ 100

1 ≤ |Pattern| ≤ 1000

1 ≤ |Text String| ≤ 100000

Sample Input and Output

Input 1:

```
3
hack
indiahacks
code
eddy
coder
Iamredoc
```

Output 1:

```
YES
NO
YES
```

5. Write a C program to implement hash table data structure using open addressing to store student’s information with roll number as key. Your program should contain the following functions:-

- **hashTable(int *m*)**- create a hash table of size m
- **insert(int *k*)**- insert element into hash table having key value as k
- **search(int *k*)**- find whether element with key ‘k’ is present in hash table or not
- **delete(int *k*)**- delete the element with key ‘k’

Input Format:

The first line contains a character from { ‘a’, ‘b’, ‘c’, ‘d’} denoting

a- Collision resolution by Linear probing with hash function

$h(k, i) = (h_1(k) + \mathrm{i}) \bmod \mathrm{m}$ where $h_1(k) = \mathrm{k} \bmod \mathrm{m}$

b - Collision resolution by Quadratic probing with hash function

$h(k, i) = (h_1(k) + c_1 i + c_2 i^2) \; mod \; m$

where $h_1(k) = \mathrm{k} \bmod \mathrm{m}$, c_1 and c_2 are positive auxiliary constants, i = 0,1,...m-1

c - Collision resolution by Double Hashing with hash functions

$h(k, i) = (h_1(k) + \mathrm{i} * h_2(k)) \bmod \mathrm{m}$

Where, $h_1(k) = \mathrm{k} \bmod \mathrm{m}$, $h_2(k)$= R - (k mod R) { R = Prime number just smaller than the size of table }

Next line contains an integer, m, denoting the size of hash table.

In case of quadratic probing only (option b) Next line contains the constants c_1 and c_2 separated by space

Next lines contains a character from { ‘i’, ‘s’, ‘d’, ‘p’, ‘t’ } followed by zero or one integer.

i x - insert the element with key x into hash table

s x - search the element with key x in hash table. Print 1 if present otherwise print -1

d x - delete the element with key x from hash table.

p - print the hash table in “index (key values)” pattern.(See sample output for explanation)

t - terminate the program

(Note : In case of Linear probing, quadratic probing and Double hashing, total elements (n) to be inserted into hash table will be lesser than or equal to the size of the hash table (m) i.e. n<=m

a. deletion operation will always be a valid operation

b. While printing the hash, multiple key values must be separated by a single white space.)

Output File Format:

The output (if any) of each command should be printed on a separate line

Sample Input and Output

Input 1:

```
a
7
i 76
i 93
i 40
i 47
i 10
i 55
p
s 35
s 47
d 47
s 55
T
```

Output 1:

```
0 (47)
1 (55)
2 (93)
3 (10)
4 ()
5 (40)
6 (76)
-1
1
1
```

Input 2:

```
b
7
0 1
i 76
i 40
i 47
i 5
s 5
```

```
i 55
p
s 62
d 55
```

Output 2:

```
1
0 (5)
1 ()
2 (47)
3 (55)
4 ()
5 (40)
6 (76)
-1
```

Input 3:

```
c
7
i 76
i 93
i 40
i 47
i 10
i 55
p
d 40
s 47
s 76
s 40
T
```

Output 3:

```
0 ()
1 (47)
2 (93)
3 (10)
```

```
4 (55)
5 (40)
6 (76)
1
1
-1
```

6. Write a program to sort an array of integers with many repetitions using AVL tree. A basic sorting algorithm like MergeSort, HeapSort would take O(nLogn) time where n is the number of elements. A better Solution is to use Self-Balancing Binary Search Tree like AVL tree to sort in O(n Log m) time where m is the number of distinct elements. The idea is to extend tree node to have count of keys also. Each node in the tree is of the following type.

```
struct node{
        int key;
        int count;              // number of times a key appears in the array
        int height;
        struct node* left;
        struct node* right;
}
```

Input Format:
First line containing the number of elements in the array.
Second line containing space separated integers of the array.

Output Format:
Single line containing space separated integers of the given input array in non-decreasing order.

Sample Input and Output:
Input 1:

```
12
100 12 100 1 1 12 100 1 12 100 1 1
```

Output 1:

```
1 1 1 1 1 12 12 12 100 100 100 100
```

Sample Output

3

8. Write a program to find the Huffman encoding for a given message using binary tree. Your program should include the following functions:

main() – reads the input as specified in the input format from the terminal and calls the appropriate functions to print the huffman code.

Find_huffman_Code(*m*) – It should build a Huffman tree for the given message *m* and assign codes by traversing the Huffman Tree. Path from the top or root of this tree to a particular node/character will determine the code group associated with that node/character.

print_Code_Length (*m*) – This function should print the total number of bits required to store the final binary code.

Input File Format:

The input consists of multiple lines, each line of the input contains a message of type string.

Output File Format:

The output consists of multiple lines each containing the total length of corresponding encoded message.

Sample Input:

```
malayalam
mississippi
```

Sample Output:

```
17
21
```