

CS F211

Data Structures and Algorithms

Assignment - 3

Two-pointers, Sliding Window and Math

Allowed Language: C

January 22, 2024

General Tips

- Try to use functions as much as possible in your code. Functions increase reusability and the pass-by-value feature provides a significant help sometimes. Modularizing your code also helps you to debug efficiently.
- Use `scanf` to read characters/strings from STDIN. Avoid using `getchar`, `getc` or `gets`. Try to read up about character suppression in `scanf` as it will be very helpful in some of the problems.
- Use `printf` instead of `putc`, `putchar` or `puts` to print character/string output on STDOUT.
- Indent your code appropriately and use proper variable names. These increase readability and writability of the code. Also, Use comments wherever necessary.
- Use a proper IDEs like Sublime Text or VSCode as they help to run and test your code on multiple test-cases easily.
- **Note:** Kindly try to do all of these questions by yourself at least once. Spend some time thinking about it, or trying to code it instead of directly asking help of your friends or searching it up online. This helps you understand the question, allowing you to solve further questions which are not in the scope of this Assignment yourself.
- **You should not use `string.h` library for any question.**

A: Nom the Bully

Karma and Ayanokoji were on a hunt to find the brainiest people like them. So they came to BITS Hyderabad and decided to enter H-Block. In order to enter there, there was a puzzle. There was a string given to them written on the floor in blocks, comprising alphabets from a to z, lowercase. They were required to find the length of the longest substring which could be read the same from either side. So they decided to brute force manually. Seeing this Nom stops them and tells them to code it instead or he'll kick them out of the campus.

Input

The first line contains an integer n ($1 \leq n \leq 3 * 10^3$).

The second line contains a string of length n consisting of only lowercase English alphabet.

Your solution should run in $O(n^2)$ time complexity.

Output

The length of the longest substring satisfying the condition.

input

5

babad

output

3

input

4

abcd

output

1

input

9

malayalam

output

9

B: Sasageyo Sasageyo

Zeke has transformed into the Beast Titan and wants to take revenge for his mother. He sees n troops coming towards him all wearing a jacket with one single letter written on it. Zeke wants to knock down as many consecutive troops as possible. But among the knocked down troops he doesn't want any repeating character. Find out the maximum number of consecutive troops he can knock down.

Input

The first line contains an integer n ($1 \leq n \leq 10^5$).

The second line contains a string of length n consisting of only lowercase English alphabet.

Your solution should run in $O(n)$ time complexity.

Output

The maximum number of consecutive troops Zeke can knock down.

input

6

pewpew

output

3

input

20

nomlikespeanutbutter

output

9

input

14

kiralikesmoney

output

10

C: DSA - Demon SlAyer

Not being able to defeat the Demon King by old means, Tanjiro decides to become the Coding Hashira. Nom and Kira help him learn a few things to do so. One day they gave him an Assignment with one question. The question was as follows:

Given a string consisting of multiple words, reverse each word in the string.

Help Tanjiro become the Coding Hashira.

Input

The first line contains an integer n ($1 \leq n \leq 10^5$).

The second line contains a string of length n consisting of only lowercase English alphabet and whitespace.

Your solution should run in $O(n)$ time complexity.

Output

A string of length n as mentioned in the problem.

input

7

pew pew

output

wep wep

input

23

nom likes peanut butter

output

mon sekil tunaep rettub

input

16

arik sekil yenom

output

kira likes money

D: Jiraiya's Legacy

Seeing Tanjiro work hard to become the Coding Hashira, Naruto decides to become the CodeKage. He goes to Jiraiya to learn even more complex techniques, who asks him to solve this problem:

Given a string, reverse the order of vowels.

Seeing him not being able to solve the problem, Jiraiya dies. Naruto decides to solve the problem to fulfil his master's last wish of seeing him become the CodeKage. Help Naruto.

Input

The first line contains an integer n ($1 \leq n \leq 10^5$).

The second line contains a string of length n consisting of only lowercase English alphabet and whitespace.

Your solution should run in $O(n)$ time complexity.

Bonus: Can you solve it using only constant extra space?

Output

A string of length n as mentioned in the problem.

input

7

pew pew

output

pew pew

input

23

nom likes peanut butter

output

nem lukus paenet bittor

input

16

kero lekis maniy

output

kira likes money

E: Nom is the Real Kira

Nom hates a lot of people, and a lot of people hate Nom. So Nom decides to give a list of names to Kira for him to write them in the Deathnote. Since Kira is his best friend, he knows that Nom uses numbers instead of names to address people. He gives Kira 2 arrays a, b of numbers in sorted order to reduce his hassle. But Kira needs all the numbers in a sorted order. Help Kira merge the arrays and wipe off Nom's enemies from existence.

Input

The first line contains two integers n and m ($1 \leq n, m \leq 10^5$).

The second line contains n integers of the first array ($1 \leq a_1 \leq a_2 \leq \dots \leq a_{n-1} \leq a_n \leq 10^9$).

The third line contains n integers of the second array ($1 \leq b_1 \leq b_2 \leq \dots \leq b_{n-1} \leq b_n \leq 10^9$).

Your solution should run in $O(n+m)$ time complexity.

Output

$n + m$ integers of the merged sorted array.

input

1 2

5

2 3

output

2 3 5

input

2 3

1 4

2 3 5

output

1 2 3 4 5

input

6 6

1 4 6 8 10 12

1 4 5 6 9 10

output

1 1 4 4 5 6 6 8 9 10 10 12

F: Cursed Problem

Gojo Satoru is not only the strongest but also the most caring Sensei. He wanted to enhance the cursed energy detection skills of his students. So he brought n cursed spirits and put them in a sequence. Then he asked his students to find the number of possible groups of k consecutive cursed spirits whose average cursed energy is not less than x .

Can you find the answer the students need to find?

Input

The first line contains three integers n, k and x ($1 \leq k \leq n \leq 10^5, 1 \leq x \leq 10^9$).

The second line contains n integers which represent the cursed energies of the cursed spirits in sequence a ($-10^9 \leq a_i \leq 10^9$).

Your solution should run in $O(n)$ time complexity.

Output

The number of possible groups of cursed spirits as mentioned in the problem.

input

5 1 3

2 3 5 -2 6

output

3

input

5 2 6

3 -4 8 5 -2

output

1

input

14 5 32

23 -11 67 2 89 -13 40 63 19 7 35 -42 10 66

output

5

G: Nom still Loves Peanut Butter

Nom the panda had a friend, Psy the panda. They both really love peanut butter. So their friend Kira put down n jars of peanut butter jars from left to right on a table. The jars are numbered from left to right. The i -th jar has weight w_i .

Nom can eat any number of jars from the left (he can't skip jars, he eats them in a row).
Psy can eat any number of jars from the right (he can't skip jars, he eats them in a row).
Of course, if Nom ate a jar, Psy can't eat it (and vice versa).

They want to be fair. Their goal is to eat the same total weight of peanut butter. What is the maximum weight of peanut butter they can eat?

Input

First line contains an integer n ($1 \leq n \leq 10^5$).
Second line contains n integers in an array a ($1 \leq a_i \leq 10^9$).
Your solution should run in $O(n)$ time complexity.

Output

The maximum weight of peanut butter Nom and Psy can eat while satisfying the condition.

input

3

10 20 10

output

10

input

9

7 3 20 5 15 1 11 8 10

output

30

```
input
4
1 2 3 4

output
0
```

H: The Scandal Continues

After making a lot of money from stocks, Kira decided to lay low for a while, He found a group of 60 clients interested in some deals he is going to make soon. He has an array a of n deals. Each deal contains 60 bits of information. Each bit corresponding to one particular client's satisfaction. Now Kira wants to take part in exactly k consecutive deals.

Find the maximum number of clients Kira can satisfy. (A client is satisfied if there is at least one deal which satisfies them, among the k deals)

Input

First line contains two integers n, k ($1 \leq k \leq n \leq 10^5$).

Second line contains n integers in an array a ($0 \leq a_i \leq 2^{60} - 1$), Each integer represents the 60 bits of a deal.

Your solution should run in $O(n)$ time complexity.

Output

The maximum number of clients Kira can satisfy.

input

5 1
1 2 6 12 3

output

2

input

6 3
2 7 14 25 9 16

output

5

input

14 5
214 35278 724888 41239 941432 14109 4539598 249289 39598 0 948359 63435 359853 839895

output

21

I: Arrival of Junji (Easy Version)

Junji is a good friend of Kira. Junji loves solving CodeLeet daily problems, and has solved a lot of them. But Kira knew that solving CodeLeet problems will only get Junji so far. So Kira decided to give Junji a more competitive problem:

Given an array of size n , find the product of all non-primes in the array modulo $(10^9 + 7)$. If there are no non-primes in the array output -1 .

Solve this problem together with Junji to get better at competitive problems.

Input

First line contains an integer n ($1 \leq n \leq 10^5$).

Second line contains n positive integers in an array a ($1 \leq a_i \leq 10^9$).

Your solution should run in $O(n\sqrt{\max(a_i)})$ time complexity.

Output

The product of all non-primes in the array mod $(10^9 + 7)$ or -1 as in problem statement.

input

3

2 6 4

output

24

input

4

2 3 5 7

output

-1

input

12

982938197 1279873819 123712 1821871 171872910 91191 198 291819 71718 1721871 23 1283781

output

476968426

J: TheHackerCat 3

Vidyateja kicked Kira from his whatsapp group. Nom could have added him back, but he was hibernating after eating his peanut butter. Vidyateja missed the anime stickers sent by Kira. So being the generous guy he is, he decided to invite Kira back if he can solve this competitive problem:

Given 2 arrays a, b of size n - find the value of the product $\prod_{i=1}^{i=n} a_i^{b_i} \bmod (10^9 + 7)$.

Help Kira solve this problem, so that he can send more anime stickers in the group.

Input

The first line contains a single integer n ($1 \leq n \leq 10^5$).

The second line contains n elements of the array a ($1 \leq a_i \leq 10^9$).

The third line contains n elements of the array b ($1 \leq b_i \leq 10^9$).

Your solution should run in $O(n \cdot \log(\max(b_i)))$ time complexity.

Output

Output a single integer equal to the product mentioned in the problem.

input

3

2 2 3

1 1 3

output

108

input

5

1 2 3 4 5

2 3 2 1 1

output

1440

input

9

83 64 37 49 53 25 90 21 13

27 46 42 63 35 52 12 39 73

output

848497203
