



South African Computer Olympiad

Final Round

Day 1



Overview

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Problem	castle	garden	lprefix
Source	castle.java castle.py castle.c castle.cpp castle.pas	garden.java garden.py garden.c garden.cpp garden.pas	lprefix.java lprefix.py lprefix.c lprefix.cpp lprefix.pas
Input file	castle.in	garden.in	lprefix.in
Output file	castle.out	garden.out	lprefix.out
Time limit	1 second	1 second	1 second
Number of tests	20	10	10
Points per test	5	10	10
Total points	100	100	100

The maximum total score is 300 points.



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Protecting The Castle Aaaaaaggh

Author

Richard Baxter and Julian Kenwood

Introduction

You are protector of the Castle Aaaaaaggh, which holds the Holy Grail, and decide it's time to buy some cannons. You have a number of defense points in which to place them. The cannons come in batches and cannot be split up (otherwise you'll invalidate the warranty). Furthermore, they are delivered by African Swallows, so you only get one batch at a time. You can direct the swallows to place them at any one of your defense points but the cannons will have to stay there. Every time you receive a batch of cannons you decide the best option is to place them at the defense point with the smallest number of cannons. For strategic reasons, at the end of this you need to find the biggest difference in cannons between any two defense points.

Task

You are given the number of batches of cannons you ordered (N) and the number of cannons in each batch (V_1, V_2, \dots, V_N) in order of delivery. Given that the Castle of Aaaaaaggh has K defense points and that each time you receive a batch of cannons you place that batch at the defense point with the smallest number of cannons, determine the biggest difference in the number of cannons between any two defense points.

Example

If $K = 3$ and $N = 4$, the castle has 3 defense points and you ordered 4 batches of cannons. Given that the size of these batches are 9, 3, 7 and 7 (received in that order), you should place your cannons at your defense points as follows:

```
0 0 0
9 0 0
9 3 0
9 3 7
9 10 7
```

The biggest difference between any two defense points at

the end is 3.

Input (castle.in)

The first line of the input contains two integers, K and N , separated by a single space. The next N lines each contain a single integer, which are V_1 to V_N .

Sample input

```
3 4
9
3
7
7
```

Output (castle.out)

The output consists of a line containing a single integer which is the maximum difference between the number of cannons at any two of the defense points after all the batches have been placed.

Sample output

```
3
```

Constraints

- $3 \leq K \leq 100$
- $1 \leq N \leq 5000$
- $1 \leq V_i \leq 50$

Scoring

A correct solution will score 100%, while an incorrect solution will score 0%.



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Round Garden

Author

Harry Wiggins

Introduction

King Arthur is very proud of the shrubberies in his round garden. The garden is a big circle with many pots, and a number of shrubberies planted in each pot. One day the King wondered how many shrubberies there were, so he sent one of his trusted Knights to count the number in each pot. It took the knight the whole day to count the lot!

Arthur soon discovered that the knight had counted incorrectly. He chose a number M . He then started at the first pot and counted all the shrubs in the next M pots. Then he went to the second pot and counted all the shrubs in the next M pots. Then he went to the third pot and counted all the shrubs in the next M pots, etc.

Arthur is furious and is now looking for somebody to work out how many shrubberies there are in each individual pot.

Task

Knowing the number of pots N , the number M the knight used and the numbers he counted, your task is to work out the number of shrubberies in each individual pot. Luckily the numbers N and M are relatively prime and therefore it is always possible to work out the individual numbers. Two positive integers are relatively prime if there is no number greater than 1 which divides both of them.

Example

Assume there were 5 pots in the garden and the knight chose $M = 3$. If the number of shrubberies in each pot was 1, 22, 33, 4, 5 the knight would have reported the numbers 56, 59, 42, 10, 28. Given the reported set of numbers, we work out that the individual numbers for each pot must have been 1, 22, 33, 4, 5.

Input (garden.in)

The first line of the input contains two space-separated integers N and M . The pots are numbered from 1 to N clock-wise around the garden. The next line contains N integers, with the i^{th} number being C_i , the total number of

shrubberies in the M pots starting from i and proceeding clock-wise.

Sample input

```
5 2
8 7 5 5 7
```

Output (garden.out)

The output must be a single line containing N space-separated integers S_i , the number of shrubberies in pots 1, 2, 3, ..., N respectively.

Sample output

```
4 4 3 2 3
```

Constraints

- $1 \leq M < N \leq 100000$
- N, M are relatively prime
- $0 \leq C_i < 2^{31}$ (so they fit in a `longint` in Pascal or `int` in other languages).
- $0 \leq S_i$

Additionally, in 50% of the test-cases:

- $N \leq 9$
- $S_i \leq 4444$

Time limit

1 second.

Scoring

A correct solution will score 100%, while an incorrect solution will score 0%.



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Longest Prefix

Author

Keegan Carruthers-Smith

Introduction

You walk past Henry Wensleydale's Cheese Shop and think that a little fermented curd will do the trick in curing your hunger. You enter the shop and ask for some cheese. Wensleydale, the shop owner, says he refuses to help you unless you can solve his problem with cheese lists.

To reduce the costs of printing his cheese lists, he can tell the printer to make a stamp for stamping a word or part of a word. Everyone knows that stamping is cheaper than printing, so if you find the longest prefix shared by at least two cheese types, you can save money by stamping the prefix instead of printing it.

Task

You are given a list of words. You must output the longest prefix shared by at least two words (the prefix may be the whole of one of the words). The longest shared prefix will always exist, and will always be at least one character long. If there is more than one possible output, you must output the prefix that comes first alphabetically.

Example

In the example input there are five prefixes that are shared by at least two words. These are C, CH, CHE, CHA, P. You would output CHA because it is the longest and is alphabetically less than CHE.

Input (lprefix.in)

The first line contains a single integer N . The next N lines each contain one word, W_i . These words contain only uppercase letters, and no two words will be the same.

Sample input

```
7
CHEDDAR
CHESO
CHAOURCE
PARMESAN
CHAUMES
ROQUEFORT
POSSIA
```

Output (lprefix.out)

The output is a line containing the single prefix L , which is the longest shared prefix. If there is more than one possible L , output the first one when they are arranged alphabetically.

Sample output

```
CHA
```

Constraints

- $2 \leq N \leq 5000$
- $2 \leq \text{length}(W_i) \leq 100$
- $1 \leq \text{length}(L) \leq 99$

Additionally, in 50% of the test-cases:

- $2 \leq N \leq 1000$
- $2 \leq \text{length}(W_i) \leq 50$

Time limit

1 second.

Scoring

A correct solution will score 100%, while an incorrect solution will score 0%.