ANZAC Round 4 – 2018

October 6, 2018

Contest Problems

A: Police Recruits
B: Crack Password
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This contest contains twleve problems. Good luck.

For problems that state "*Your answer should have an absolute or relative error of less than* 10^{-6}", your answer, x, will be compared to the correct answer, y. If $|x - y| < 10^{-6}$ or $\frac{|x-y|}{|y|} < 10^{-6}$, then your answer will be considered correct.

Definition 1

For problems that ask for a result modulo m:
If the correct answer to the problem is the integer b, then you should display the unique value a such that:

- $0 \leq a < m$
  and
- $(a - b)$ is a multiple of m.

Definition 2

A string $s_1 s_2 \cdots s_n$ is lexicographically smaller than $t_1 t_2 \cdots t_\ell$ if

- there exists $k \leq \min(n, \ell)$ such that $s_i = t_i$ for all $1 \leq i < k$ and $s_k < t_k$
  or
- $s_i = t_i$ for all $1 \leq i \leq \min(n, \ell)$ and $n < \ell$.

Definition 3

- Uppercase letters are the uppercase English letters ($A, B, \ldots, Z$).
- Lowercase letters are the lowercase English letters ($a, b, \ldots, z$).

Problem A
Police Recruits
Time limit: 1 second

The police department of your city has just started. Initially, they don't have any manpower. So, they started hiring new recruits in groups.

Meanwhile, crimes keeps occurring within the city. One member of the police force can investigate only one crime during his/her lifetime.

If there is no police officer free (isn't busy with crime) during the occurrence of a crime, it will go unsolved.

Given the chronological order of crime occurrences and recruit hirings, find the number of crimes which will go unsolved.

Input

The first line of input contains an integer n ($1 \leq n \leq 10^5$), the number of events. The next line contains n space-separated integers.

If the integer is -1 then it means a crime has occurred. Otherwise, the integer will be positive, the number of officers recruited together at that time. No more than 10 officers will be recruited at a time.

Output

Print a single integer, the number of crimes which will go unsolved.

Sample Input 1	Sample Output 1
11 -1 -1 2 -1 -1 -1 -1 -1 -1 -1 -1	8

Sample Input 2	Sample Output 2
3 -1 -1 1	2

Sample Input 3	Sample Output 3
8 1 -1 1 -1 -1 1 1 1	1

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Problem B
Crack Password
Time limit: 1 second

Recently we update the security system in Monash Claytown campus. The new system now supports an unlimited length password.

A password in the system is an integer (it can be as large as you want). For the sake of security, instead of storing password itself, we store the `compressed-key` of a password in our database. The `compressed-key` is the sum of each digit of the password. For example, the `compressed-key` of password `12390` is 15 ($1 + 2 + 3 + 9 + 0$).

Given a compressed-key, what is the minimum value of the corresponding password?

Input

An integer $1 \leq n \leq 10^4$, the compressed key of a password.

Output

Display the minimum value of the corresponding password.

Sample Input 1	Sample Output 1
`15`	`69`

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Problem C
Tic-Tac-Toe-Tomek
Time limit: 1 second

Tic-Tac-Toe-Tomek is a game played on a 4 x 4 square board. The board starts empty, except that a single 'T' symbol may appear in one of the 16 squares. There are two players: X and O. They take turns to make moves, with X starting. In each move a player puts her symbol in one of the empty squares. Player X's symbol is 'X', and player O's symbol is 'O'.

After a player's move, if there is a row, column or a diagonal containing 4 of that player's symbols, or containing 3 of her symbols and the 'T' symbol, she wins and the game ends. Otherwise the game continues with the other player's move. If all of the fields are filled with symbols and nobody won, the game ends in a draw. See the sample input for examples of various winning positions.

Given a 4 x 4 board description containing 'X', 'O', 'T' and '.' characters (where '.' represents an empty square), describing the current state of a game, determine the status of the Tic-Tac-Toe-Tomek game going on. The statuses to choose from are:

- "X won" (the game is over, and X won)
- "O won" (the game is over, and O won)
- "Draw" (the game is over, and it ended in a draw)
- "Game has not completed" (the game is not over yet)

If there are empty cells, and the game is not over, you should output "Game has not completed", even if the outcome of the game is inevitable.

The game board provided will represent a valid state that was reached through play of the game Tic-Tac-Toe-Tomek as described above.

Input

Four lines with 4 characters each, with each character being `X`, `O`, `.` or `T`.

Output

Display the current status of the game.

Sample Input 1

```
XOXT
XXOO
OXOX
XXOO
```

Sample Output 1

```
Draw
```

Sample Input 2

```
OOXX
OXXX
OX.T
O..O
```

Sample Output 2

```
O won
```

Sample Input 3

```
XXXT
....
OO..
....
```

Sample Output 3

```
X won
```

Sample Input 4

```
XOX.
OX..
....
....
```

Sample Output 4

```
Game has not completed
```

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Problem D
Joysticks
Time limit: 1 second

Friends are going to play console. They have two joysticks and only one charger for them. Initially, the first joystick is charged at a_1 percent and second one is charged at a_2 percent. You can connect the charger to a joystick only at the beginning of each minute. In one minute a joystick either discharges by 2 percent (if not connected to a charger) or charges by 1 percent (if connected to a charger).

The game continues while both joysticks have a positive charge. Hence, if at the beginning of minute some joystick is charged by 1 percent, it has to be connected to a charger, otherwise the game stops. If some joystick completely discharges (its charge turns to 0), the game also stops.

Determine the maximum number of minutes that the game can last. It is prohibited to pause the game, i. e. at each moment both joysticks should be enabled. It is allowed for joystick to be charged by **more than 100 percent**.

Input

The first line of the input contains two positive integers a_1 and a_2 ($1 \le a_1, a_2 \le 100$), the initial charge level of first and second joystick respectively.

Output

Display the maximum number of minutes that the game can last. The game continues until some joystick is discharged.

Sample Input 1	Sample Output 1
1 1	0

Sample Input 2	Sample Output 2
3 5	6

Sample Input 3	Sample Output 3
4 4	5

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Problem E
Sequence Adjustment
Time limit: 3 seconds

You have a sequence comprising n integers. You can choose a continuous subsequence and add 1 or subtract 1 from all the numbers in the subsequence. Your task is to make all the numbers the same using the least tries. You should calculate the number of the least tries you need and the number of different final sequences with the least tries.

Input

The first line contains one integer n ($1 \leq n \leq 10^6$). The second line contains n integers in range $[1, 10^9]$.

Output

Display two integers x and y, where x is the number of the least tries you need, and y is the number of different final sequences with the least tries.

Sample Input 1	Sample Output 1
2 2 4	2 3

Sample Input 2	Sample Output 2
6 1 1 1 2 2 2	1 2

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Problem F
Cows' Prizes
Time limit: 1 second

Today is ANZACOW round four and the cows are excited. They are going to prepare prizes for teams! Since the dairy factory closes on Saturday, there are only three ingredients available: **apples**, **bananas** and **candy**.

The cows combine these ingredients to produce three types of prizes:

- **Type 1**: one apple, one banana and one candy;
- **Type 2**: one apple and two banana;
- **Type 3**: two apple and one banana;

The cows have a apples, b bananas and c candies. They wrap up prizes and send to teams one by one. To bring teams more surprises, they guarantee that adjacent prizes are different types. The cows want to know the maximum number of teams that can get a prize.

Input

The input comprises three integers a, b, c ($0 \leq c \leq b \leq a \leq 10^5$).

Output

Display the maximum number of teams can get a prize.

Sample Input 1	Sample Output 1
3 3 3	2

Sample Input 2	Sample Output 2
4 4 0	2

Sample Input 3	Sample Output 3
2 2 2	1

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Problem G
File Fix-it
Time limit: 1 second

On Unix computers, data is stored in directories. There is one root directory, and this might have several directories contained inside of it, each with different names. These directories might have even more directories contained inside of them, and so on.

A directory is uniquely identified by its name and its parent directory (the directory it is directly contained in). This is usually encoded in a path, which consists of several parts each preceded by a forward slash ('/'). The final part is the name of the directory, and everything else gives the path of its parent directory. For example, consider the path:

`/home/anzac/round4`

This refers to the directory with name `round4` in the directory described by `/home/anzac`, which in turn refers to the directory with name `anzac` in the directory described by the path `/home`. In this path, there is only one part, which means it refers to the directory with the name `home` in the root directory.

To create a directory, you can use the `mkdir` command. You specify a path, and then mkdir will create the directory described by that path, but only if the parent directory already exists. For example, if you wanted to create the `/home/anzac/round4` and `/home/anzac/finals` directories from scratch, you would need four commands:

- `mkdir /home`
- `mkdir /home/anzac`
- `mkdir /home/anzac/round4`
- `mkdir /home/anzac/finals`

Given the full set of directories already existing on your computer, and a set of new directories you want to create if they do not already exist, how many mkdir commands do you need to use?

A path consists of one or more lower-case alpha-numeric strings (i.e., strings containing only the symbols 'a'-'z' and '0'-'9'), each preceded by a single forward slash. These alpha-numeric strings are never empty.

Input

The first line contains two integer n ($0 \leq n \leq 100$) and m ($1 \leq m \leq 100$).

The next n lines each give the path of one directory that already exists on your computer. This list will include every directory already on your computer other than the root directory. (The root directory is on every computer, so there is no need to list it explicitly.)

If a directory is listed as being on your computer, then its parent directory will also be listed, unless the parent is the root directory.

The next m lines each give the path of one directory that you want to create.

The input file will be no longer than 100 000 bytes in total.

Output

Display one integer, the number of `mkdir` commands you need.

Sample Input 1	Sample Output 1
1 3 /a /a/b /a/c /b/b	4

Sample Input 2	Sample Output 2
0 2 /home/anzac/round4 /home/anzac/finals	4

Sample Input 3	Sample Output 3
2 1 /darcy /darcy/best /darcy	0

Problem H
ACM/ICPC Winner
Time limit: 1 second

The International Coffee Presentation Contest (ICPC) is the most famous event in the world organized by Association for Coffee Machine (ACM). Darcy and Daniel are coffee lovers, and they participate in the contest and meet in the final round.

In the final round, there are n cups of coffees in a line, and the players make moves in turn:

- in each move, the player chooses two nonempty cups of adjacent coffee and drink;
- each cup of coffee can be drunk at most once;
- the player who can not make any move loses the game;

Daniel moves first because of the lexicographical order of his name, and he wants to know whether there is a strategy to win the game.

Notice that both Daniel and Darcy are very smart and always make the optimal move.

Input

One line: an integer n ($1 \leq n \leq 3000$).

Output

Print a string on one line: if Daniel has a win strategy print **yes**, otherwise **no**

Sample Input 1	Sample Output 1
1	no

Sample Input 2	Sample Output 2
3	yes

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Problem I
Alien Tree
Time limit: 1 second

Daniel is doing his PhD on genealogy specializing in the family trees of aliens. Different from humans, aliens reproduce by fission. Daniel notices that the family tree of aliens is the same as a tree in computer science:

- Except for the true ancestor alien, each alien has exactly one parent;
- Each alien may have multiple children;
- There is no cycle in the family tree;

Daniel has an array of integers which describes the total degree of each node (the total number of edges connected to the node) in a family tree. He is interested in the maximum possible distance of any two aliens in a family tree corresponding to this degree array.

The distance between two aliens is the minimum number of steps along the family tree to travel from one to another. A step can move from the current node to any of its children, or to its parent. The distance between an alien and itself is zero.

Input

The first line contains one integer n ($1 \leq n \leq 10^5$). The next line contains n integers in the range $[0, n-1]$, which is the degrees of the n nodes.

Output

Display the maximum distance of any two aliens. Display -1 if the input could not describe a tree.

Sample Input 1

```
3
1 2 1
```

Sample Output 1

```
2
```

Sample Input 2

```
3
2 2 2
```

Sample Output 2

```
-1
```

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Problem J
Number of Ways
Time limit: 1 second

You have an array with n integers: $a_1, a_2, \ldots, a_n$. Count the number of ways to split all the elements of the array into three contiguous parts so that the sum of elements in each part is the same.

More formally, you need to find the number of such pairs of indices i, j ($2 \leq i \leq j \leq n-1$), that:

$$\sum_{k=1}^{i-1} a_k = \sum_{k=i}^{j} a_k = \sum_{k=j+1}^{n} a_k$$

Input

The first line contains an integer n ($1 \leq n \leq 5 \times 10^5$), how many numbers are in the array. The next line contains n integers $a_1, \ldots, a_n$ ($-10^9 \leq a_i \leq 10^9$).

Output

Display the number of ways to split the array into three parts with the same sum.

Sample Input 1	Sample Output 1
2 4 1	0

Sample Input 2	Sample Output 2
5 1 2 3 0 3	2

Sample Input 3	Sample Output 3
4 0 1 -1 0	1

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Problem K
Convenient Traffic
Time limit: 3 seconds

Monash University is going to build a new railway to link the Coalfield and Claytown campuses. We already have the blueprint. There are n vertices in the blueprint (1 to n), and we know the length of each directed edge from i to j.

Let $d(u, v, w)$ be the length of shortest path from u to w that does not pass through v, $d(u, v, w) = -1$ if there is no such path. The **convenience value** P is:

$$P = \sum_{1 \le x,y,z \le n, x \ne y, y \ne z} d(x, y, z)$$

We want to know the **convenience value** of the given traffic blueprint.

Input

The first line contains one integer n ($4 \le n \le 300$), the number of vertices in the blueprint. Each of the next n lines contains n integers. The jth integer of the ith line $G_{i,j}$ ($-1 \le G_{i,j} \le 10^4, G_{i,i} = 0$) represents the length of directed edge from vertex i to vertex j. $G_{i,j} = -1$ means that no edge from i to j.

Output

Display P.

Sample Input 1	Sample Output 1
4 0 1 -1 -1 -1 0 1 -1 -1 -1 0 1 1 -1 -1 0	4

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Problem L
Square Palindrome
Time limit: 1 second

A palindrome is just an integer that reads the same backwards and forwards - so 6, 11 and 121 are all palindromes, while 10, 12, 223 and 2244 are not (even though 010=10, we don't consider leading zeroes when determining whether a number is a palindrome).

A square palindrome is a number that is a palindrome and the square of a palindrome at the same time. For instance, 1, 9 and 121 are square palindrome, while 16, 22 and 676 are not. (16 is not a palindrome, 22 is not a square, and while 676 is a palindrome and a square number, the square root 26 is not a palindrome.)

Given an interval, your task is to compute how many square palindromes in the interval.

Input

The input contains two integers L and R ($1 \leq L \leq R \leq 10^{14}$): the interval.

Output

Display the number of square palindrome in the interval.

Sample Input 1	Sample Output 1
1 4	2

Sample Input 2	Sample Output 2
10 120	0

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