IDI Open Programming Contest April 16th, 2016

Problem Set

A Lucky Numbers
B Memory Game
C Time Travelling Temperatures (Easy)
D Pizza Crust
E Get Off My Lawn
F What Does It Mean
G Building Fences
H Palindrome Names (Easy)
I Bing It On

Jury and Problem Writers

Torbjørn Morland (Head Judge)
Karl Johan Heimark
Magne Vikjord
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Tips

- Tear the problem set apart and share the problems among you.
- Problems are not ordered by difficulty.
- Try solving the easy problems first. Two problems in this set are tagged with "(Easy)" to help point you in the right direction.
- If your solution fails on a problem, you can print your program and debug it on paper while you let someone else work on a different problem on the computer.
- If you need help, contact the judges.

Rules

- Each team consists of one to three contestants.
- One computer is used per team.
- You may not cooperate with persons not on your team.
- You may print your programs on paper to debug them.
- What you may bring to the contest:
  - Any written material (Books, manuals, handwritten notes, printed notes, etc).
  - Pens, pencils, blank paper, stapler and other useful non-electronic office equipment.
  - NO material in electronic form (CDs, USB pen and so on).
  - NO electronic devices (PDAs and so on).
- The only electronic content you may consult during the content is that specified by the organiser (see the web-page). You may not copy source code from web pages, etc.
- Your programs should read from standard in and write to standard out. Writing to standard error will result in a failed submission. C programs should return 0 from `main()`.
- Your program may use at most 100MB of memory.
- Your programs may not:
  - access the network,
  - read or write files on the system,
  - talk to other processes,
  - fork,
  - or similar stuff.
  - If you try, your program will hang or crash. If it hangs, it will take a couple of minutes before others will be able to run their programs. So please make an effort to not crack/break what we have spent our spare time preparing for you.
- Show common sense and good sportsmanship.

Problem A

Lucky Numbers

Mr. Lucky has a store that sells numbers. These numbers have an interesting property: Each number formed by its first k digits is divisible by k, for k from 1 to n, where n is the number of digits in the number. The numbers do not have leading zeroes.

Mr. Unlucky wants to open a competing store. Price for lucky numbers is driven by demand and supply, and given by the formula $price = demand/supply$. Demand for numbers with n digits is given by the formula $demand = city\_size \cdot day\_of\_month - n^e$. Supply for lucky numbers with n digits is simply the number of lucky numbers with n digits.

Help Mr. Unlucky calculate the supply for n digit lucky numbers.

Input specifications

Each test case consists of a line with a single integer n.

Output specifications

Output a line with the supply for n digit lucky numbers.

Notes and Constraints

- $2 \leq n \leq 1\,000$

Sample Input 1

```
2
```

Sample Output 1

```
45
```

Sample Input 2

```
3
```

Sample Output 2

```
150
```

Problem B

Memory Game

The game of Memory is played with N pairs of cards where each pair has the same picture, i.e. there are N different pictures, and each of them appear on exactly two cards.

The cards are shuffled and placed face down on a large table. On each turn you flip two cards of your choice face up. If they match you remove them from the game, and if they don't match, you turn them face down. The goal of the game is to remove all cards from the game.

Your strategy is simple:

- Turn a random card that you have not looked at before face up.
- If it matches a card you have seen, turn the matching card face up (You have excellent memory).
- If the first card did not match a card you had seen before, turn another random unknown card face up.

Given this strategy, what is the expected number of turns you have to play in order to finish the game?

Input specifications

Each test case contains a line with a single integer N, the number of pairs of cards.

Output specifications

Output a line with the expected number of turns needed to finish the game. This number must have an absolute or relative error of at most 10^{-6}.

Notes and Constraints

- $1 \leq N \leq 1\,000$

Sample Input 1

```
1
```

Sample Output 1

```
1.000000000
```

Sample Input 2

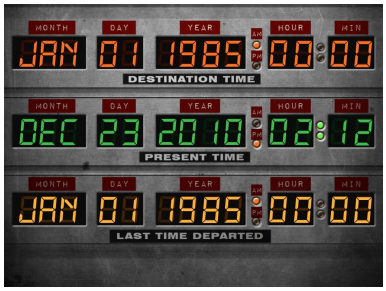
```
2
```

Sample Output 2

```
2.666666666667
```

Problem C

Time Travelling Temperatures



Hello from the future. I am a time traveller. You would think that in the future we have agreed to use a single scale for measuring temperature. This is not so. In fact, we have all sorts of scales now. All the big brands have made their own. This is a bit confusing. Please help me figure it out. In my day to day work I have to relate to two different scales A and B. Help me find a temperature where the two scales are the same, so I don't have to worry about it.

Input

Each test case consists of two space-separated integers, X and Y. X is the point on B where A is zero. Y is the number of degrees in B that equal a change of a single degree in A.

Output

Output a line with the temperature where both scales are the same. This number must have an absolute or relative error of at most 10^{-6}. If no such temperature exists, output "IMPOSSIBLE" (without the quotes) instead. If more than one such point exists, output "ALL GOOD" (without the quotes) instead.

Limits

- $-100 \leq X \leq 100$
- $1 \leq Y \leq 100$

Sample Input 1

```
32 2
```

Sample Output 1

```
-32
```

Sample Input 2

```
1 3
```

Sample Output 2

```
-0.500000000
```

Problem D

Pizza Crust

George has bought a pizza. George loves cheese. George thinks the pizza does not have enough cheese. George gets angry.

George's pizza is round, and has a radius of R cm. The outermost C cm is crust, and does not have cheese. How many percent of George's pizza has cheese?

Input specifications

Each test case consists of a single line with two space separated integers, R and C.

Output specifications

For each test case, output the percentage of the pizza that has cheese. Your answer must have an absolute or relative error of at most $10^{-}6$.

Notes and Constraints

- $1 \leq C \leq R \leq 100$

Sample Input 1

```
1 1
```

Sample Output 1

```
0.000000000
```

Sample Input 2

```
2 1
```

Sample Output 2

```
25.000000
```

Problem E

Get Off My Lawn!

Tom the Straight Builder has finally finished building his Great Wall. Being a Straight Builder he has of course built a wall with no bends in it at all. And as far as you can see he has built this wall infinitely long and infinitely thin.

On one side of the wall Tom's wife Ellen has decided she wants to make a perfect lawn. It is not very important to Ellen (or Tom for that matter) what shape it has or exactly where it is located, but Ellen requires the lawn to be at least L square meters.

To guard this pristine lawn from annoying trespassers Ellen has brought her dog William. William is a vicious dog and will attack any human being except Ellen upon sight. William can not cross the wall in any way. To reduce his own mutilations Tom has decided to tie William up with a chain to a pole and minimize the area he can cover while still being able to cover the whole lawn. The pole has been placed at location (0,0) and Tom is not able to move it (it is after all the center of the universe).

Tom needs to know what length of dog chain he needs to buy in the hardware store. Specifically he wants to know the shortest length chain in whole meters he can buy so that the dog is able to cover an area of at least L square meters.

Input

Each test case begins with a line consisting of one integer L indicating the size of the lawn. The next line contains two integers x_1 and y_1, followed by another line containing two integers x_2 and y_2. These indicate that the wall passes through the points (x_1, y_1) and (x_2, y_2).

Output

For each test case, output a line with the chain length Tom needs to acquire in meters.

Limits

- $1 \leq L \leq 10\,000$
- $-10\,000 \leq x_1, y_1, x_2, y_2 \leq 10\,000$
- $(x_1, y_1) \neq (x_2, y_2)$

Sample Input 1

```
4
-10 0
-10 10
```

Sample Input 2

```
314
100 100
-100 -100
```

Sample Output 1

```
2
```

Sample Output 2

```
15
```

Problem F

What Does It Mean?

Bob has always been interested in his family history, and above all else his family name's meaning. Unfortunately for Bob, no one else in his family has ever had any similar interest whatsoever. Because of this the family name seems to have changed at random points in time without any reason that Bob can find.

By concatenating 1 or more dictionary words to construct exactly the family name, count the number of different meanings associated with these different constructions.

Input

Each of the test cases begins with a line consisting of an integer N and a word W, indicating the number of words in the dictionary and the family name respectively. The following N lines contain the dictionary. Each dictionary line starts with the dictionary word followed by an integer representing the number of meanings of the word.

Output

For each test case, output a line with number of possible meanings Bob's family name can have. As this number can be very large, output it modulo 1 000 000 007.

Limits

- $1 \leq N \leq 1\,000$
- $1 \leq len(W)$, length of words in dictionary ≤ 32
- The number of meanings of a word in the dictionary is at least 1 and at most 10 000.
- All words (W or words and descriptions in the dictionary) contains only the letters a-z.

Sample Input 1

```
5 heimark
hei 2
mark 2
heim 1
ark 2
heima 1
```

Sample Output 1

```
6
```

Problem G

Building Fences

Donald is a fence builder. He wants to build a fence that is $N-1$ meters long. He needs a fence post every meter along the fence, which means he needs N fence posts. Donald has K poles of varying lengths that he wants to use as fence posts. The fence posts must have the same lengths, and be as long as possible. Also, the parts of the poles that are not used for the posts must not be longer than the ones used for the posts. Donald can cut the poles as many times as he wants, and at any position he wants. However, cutting a pole takes time, so he wants to make as few cuts as possible while achieving his other goals.

How many cuts does Donald have to make to get the fence posts for his fence?

Input

Each test case starts with a line with two space separated integers, K and N. The next line consists of K space separated integers p_1, p_2, ..., p_K, where p_i represents the length of the ith pole.

Output

Output a line with a single integer representing the minimum number of cuts he has to make to build his fence.

Limits

- $1 \leq K \leq N \leq 10\,000$
- $1 \leq p_i \leq 10\,000$

Sample Input 1

```
1 2
3
```

Sample Output 1

```
1
```

Sample Input 2

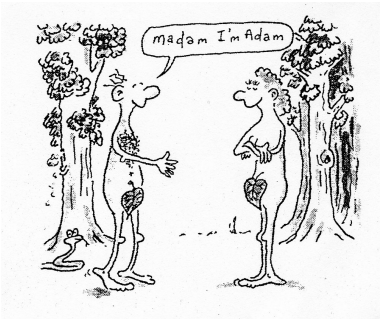
```
2 5
4 2
```

Sample Output 2

```
4
```

Problem H

Palindrome Names



Anna and Bob are having a baby. They both enjoy the advantage of having palindrome names, meaning that their names are spelled the same way forwards and backwards. Wanting to be good parents, they decide to give their child a palindrome name too. The only problem is that they aren't sure if the one they picked is a palindrome. If it turns out it isn't a palindrome, they want to change it to a palindrome using as few changes as possible. The allowed changes are:

- Change one letter of the name
- Add a letter to the end of the name

Help Bob and Anna find out how many changes they need to make to the name to make it a palindrome.

Input specifications

Each test case consists of a single line with the name they have chosen.

Output specifications

Output a single integer representing the number of changes they need to make

Notes and Constraints

- $1 \leq$ The length of the name ≤ 100
- The name will consist of only lowercase letters a-z

Sample Input 1

```
kaia
```

Sample Output 1

```
1
```

Sample Input 2

```
abcdefgded
```

Sample Output 2

```
4
```

Problem I

Bing It On

Bing wants to showcase its clear superiority over Alphabet's lesser known search engine in the great bing-it challenge of 2016. In order to do this, they have pulled out all the stops and decided to hire the very best of the best of Norwegian engineers to do the work for them. Bing knows that performance is the name of the game when it comes to the world wide web, and because of this they want to make their typeahead is as performant as possible. Your task is to analyze the stream of searches coming in, and let everyone know how many of these searches began with the letters currently in the search bar.

Input

Each test case begins with a line with a single integer N. Then follow N lines consisting of words with the characters a-z.

Output

For each word, output a line with a single integer representing how many of the *previous* words began with or was equal to that word.

Limits

- $1 \leq N \leq 100\,000$
- each word is at least 1 character and at most 32 characters

Sample Input 1

```
10
histories
adventure
history
his
ad
hi
advent
mouse
cat
his
```

Sample Output 1

```
0
0
0
2
1
3
1
0
0
3
```