Aufgaben
Get Connected to ICPC
Local Contest 2012

Zugang zum Contest:

Wiki: `http://icpc.ira.uka.de/public/wettbewerbe/getconnected2012`

Wettbewerbsserver: `http://domjudge.iti.uni-karlsruhe.de/team/`

Contents

0 SimpleSum

0.1 Problem

Given a sequence of $n \in [1, 1000]$ integer numbers $a_1 \dots a_n$ with $0 \leq a_i \leq 100$ compute the sum $s = \sum_{i=1}^{n} a_i$.

0.2 Input

The first line contains a single integer n. The next n each contain a single integer representing the a_i.

0.3 Output

Output the sum s followed by a newline character.

0.4 Sample input

```
3
1
2
42
```

0.5 Sample output

```
45
```

1 Chocolate Bar

1.1 Problem

Assume you have a chocolate bar consisting, as usual, of a number of $w \times h$ squares arranged in a rectangular pattern. Your task is to split the bar into small 1×1 squares (always breaking along the lines between the squares) with a minimum number of breaks. A break consists of a straight line cut through a piece of the bar that goes from one side to the other. You can not break the squares. You can only break one piece at a time. Stacking two pieces and breaking them in one go counts as two breaks. How many breaks do you need at least?

1.2 Input

The input consists of several testcases. Each testcase is on a line of its own and consists of the two integer numbers $1 \leq w \leq 2^{13}$ and $1 \leq h \leq 2^{13}$.

1.3 Output

For every case in the input, output one line containing the smallest number of breaks. Every line is terminated by a newline character.

1.4 Sample input

```
6 5
1 100
6423 4245
```

1.5 Sample output

```
29
99
27265634
```

2 Light Bulbs

2.1 Problem

To make the lives of their students simpler, the Unseen University decided to demolish their entire infrastructure and replace it with a single central building. This building consists of infinitely many rooms labelled 1, 2, et cetera, each of which contains exactly one light bulb.

To save costs, the planing committee chose to spend the amount of money which had to be used for art on a fancy lighting system. The artists responsible for the project constructed a nice pattern for turning the light bulbs in the rooms on and off: At the beginning all the lights are switched off, then the lights in every room are toggled, then in every second room (rooms 2, 4, 6, ...), in every third (rooms 3, 6, 9, ...) and so on. Toggling a light bulb means switching it from on to off and vice versa.

Although the employees of the university are delighted about the enrichment of their work day by art, they are also concerned that they are going to sit in the dark after the project has run its course. So they decide that everyone should move to a room which will be lit after the whole pattern has been completed. To not cause undue confusion, they want to remain in the same order, i.e. the occupant of room i should move to the i-th lit room. Note that although the whole lighting pattern has an infinite number of steps, a given light bulb is only affected by a finite number of them. So we can unambiguously say whether it will be switched on or off at the end.

Can you help them determine which rooms they should move to?

2.2 Input

The input contains the number of test cases nr ($1 \leq nr \leq 100000$) on the first line. For each test case a line containing an original room number n ($1 \leq n \leq 2^{13}$) follows.

2.3 Output

For each test case, print the number of the n-th lit room on a separate line.

2.4 Sample input

```
3
1
67
2485
```

2.5 Sample output

```
1
4489
6175225
```

3 Domino

3.1 Problem

You are given a chessboard of size $2 \times n$ and n indistinguishable domino stones. Determine the number of possibilities to fill this board with these stones so that each stone is placed on exactly 2 fields. As the number of possibilities can become very large, you should output the result modulo $p = 999999001$.

3.2 Input

The input contains the number of test cases nr ($1 \leq nr \leq 50000$) on the first line. For each test case a line containing exactly one integer, the number n ($1 \leq n \leq 10^6$), follows.

3.3 Output

For each test case you should output the number of possibilities modulo p on a line of its own.

3.4 Sample input

```
4
42
9
333333
1000000
```

3.5 Sample output

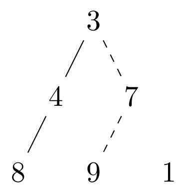
```
433494437
55
399696940
745641431
```

4 Waterfall

4.1 Problem

Once upon a time, a waterfall managed to free himself from the oppression by the laws of nature. He could now choose the path he fancied and not just the one foisted upon him by gravity. Still, he doesn't want to be to too radical. So he decides to move using a nice rule: Start at the top of your favorite mountain and go left or right at predetermined heights till you get to the ground, i.e. move along a triangle of points like the one depicted below. Since he is a very sociable fall of water, he wants to pick up as many of his friends, who wait at the branch points, as possible.

Unfortunately, his friends don't wait on just one path. So the number of friends he can pick up depends on the path. For example, in the situation below he can pick up $3 + 4 + 8 = 15$ friends along the filled path and $3 + 7 + 9 = 19$ along the dashed one (which is the best he can do).



Help the waterfall by determining how many friends he can pick up at most.

4.2 Input

The input contains the number of test cases nr ($1 \leq nr \leq 100$) on the first line. Every of the nr test cases consists of a line containing the number of rows n ($1 \leq n \leq 1000$) of the triangular pattern, followed by n lines each describing one row of the triangle. The i-th of these lines consists of the i numbers of the i-th row of the triangle separated by spaces. The numbers in the triangle are non-negative and at most 10000.

4.3 Output

For each test case, print the maximum number of friends that can be picked up on a separate line.

4.4 Sample input

```
2
3
```

```
3
4 7
8 9 1
5
1
1 0
0 1 0
0 0 1 0
0 0 1 0 0
```

4.5 Sample output

```
19
5
```

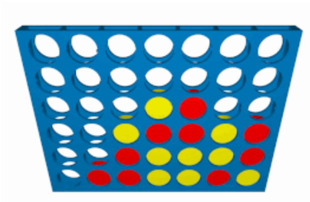
5 Connect Four

5.1 Problem

Jimmy wants to create an all-powerful AI to take over the world and is confident that the key is to be able to determine the winning player in a given sequence of moves in the game Connect Four.

If you don't know Connect Four you should be ashamed of yourself and read the following excerpt from Wikipedia:

> *Connect Four is a two-player game in which the players first choose a color and then take turns dropping their colored discs from the top into a seven-column, six-row vertically-suspended grid. The pieces fall straight down, occupying the next available space within the column. The object of the game is to connect four of one's own discs of the same color next to each other vertically, horizontally, or diagonally before one's opponent can do so.*



The red player has won this game.

5.2 Input

The first line of the input contains an integer denoting the number of test cases c that follow $(0 \leq c \leq 100000)$. Each test case consists of one line containing the number of moves m $(0 \leq m \leq 7 \cdot 6 = 42)$ and m integers $c_i \in \{1, 2, \ldots 7\}$ denoting the column that was used for the i-th move $(1 \leq i \leq m)$. You can assume that the input will not suggest to throw a disc into a column that is already full. But the list of moves may continue although a winner has already been found and the game was already over. The list of moves may also end although no winner has been found (yet).

5.3 Output

For each test case you should output one line containing the integer:

- `0`: If there is no winner.
- `1`: If the winner is the player who made the first move.
- `2`: If the winner is the player who made the second move.

5.4 Sample input

```
6
8 1 2 1 2 1 2 1 2
7 4 4 3 3 5 6 2
1 4
42 1 1 1 1 1 1 2 2 2 2 2 2 5 5 5 5 5 5 6 6 6 6 6 3 3 3 3 3 3 4 4 4 4 4 4 7 7 7 7 7 7 6
10 3 3 4 2 4 4 5 5 5 5
14 1 1 2 2 3 3 5 5 6 6 7 7 4 4
```

5.5 Sample output

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

6 Maze

6.1 Problem

While eagerly studying for the final exams, an enthusiastic computer science student was haunted by the weird dream of being trapped in a screensaver one night. He was surrounded by brick walls forming a complicated maze and started to look for an exit. Just as he began wondering if there was any exit at all, he awakened soaked in sweat and immediately started to try to solve the problem using his beloved computer.

6.2 Input

The input starts with three lines containing the maze's width w ($3 \leq w \leq 100$) and height h ($3 \leq h \leq 100$), the start position x_s, y_s and the exit position x_e, y_e, respectively. The points in the maze are indexed by a coordinate system which sits at its top left corner with the x-direction pointing right and the y-direction downward.

The remaining h lines contain a depiction of the maze where a 1 as x-th number of line y means that the position x, y is blocked by a wall (we count from 0). Free tiles are denoted by a 0.

The maze is guaranteed to be surrounded by a wall and the start position will never be a wall tile.

6.3 Output

You should print "Y" if the exit position is reachable from the start position by only moving horizontally and vertically; else "N".

6.4 Sample input

```
5 4
1 1
3 1
1 1 1 1 1
1 0 1 0 1
1 0 0 0 1
1 1 1 1 1
```

6.5 Sample output

```
Y
```

7 Cow Shed

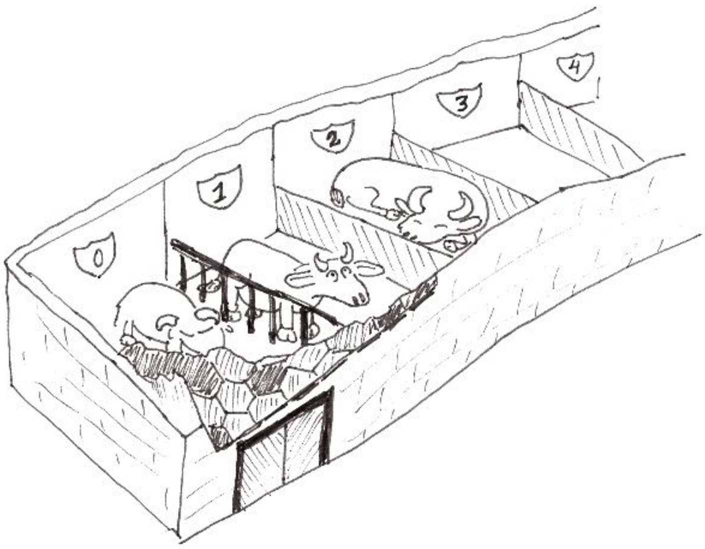
7.1 Problem

The entire roof of your cow shed has been blown away by a tornado. Fortunately, the cows are still standing at their positions, impassive as ever, and the walls have been left intact as well. But the next big rain is about to come, so you have to hurry to get a new roof up, at least above the inhabited parts, to prevent your cows from getting soaking wet.

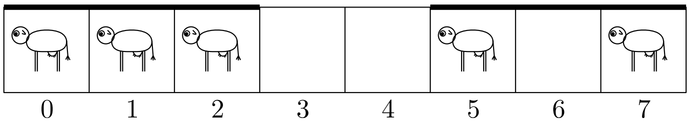
Your shed is arranged as one long row of square cells, some of which are occupied by a cow, while some may be not, as you had to cut down on cattle due to the low milk prices. Each cell is separated from the next one by a wall. As you forgot to add doors to the walls, and the cows are tied to the ground, have grown accustomed to their cell, and are currently asleep, it's downright impossible to move any of them to a different cell.

You want to put a roof over each cell that a cow resides in. Your local carpenter has a large supply of plywood, a long plank which just happens to have the width of your shack. As this is a Do-It-Yourself store, however, you have to cut the plywood into appropriately sized chunks yourself. But your buzzsaw is old and rusty, and it is capable of only doing c more cuts before falling apart. So you have to cover all cells cows are in with c pieces of plywood, you can choose the length of. You want to minimize the cost and, therefore, the total area of plywood you buy.

What is the minimal area of plywood you need to buy in order to put a roof over all cows under the given conditions?



Current situation.



Schematic situation from the first sample input, with new roof.

7.2 Input

On the first line one positive integer: the number of test cases, at most 100, followed by a blank line. After that per test case:

- One line containing n, m and c ($1 \leq c \leq m \leq n \leq 10000$) the number of cells, cows and plywood pieces respectively, separated by spaces.
- The next line contains m integers between 0 and $n-1$, in strictly ascending order, each describing the position of one cow.

Each test case is followed by a blank line.

7.3 Output

Per test case:

- One line with the minimum area (in cells) of plywood required, followed by a line break.

7.4 Sample input

```
2

8 5 2
0 1 2 5 7

10000 2 1
1 9998

```

7.5 Sample output

```
6
9998
```

8 Haters gonna hate

8.1 Problem

The Dean of the Faculty of Computer Science, the generous man he is, invites all his students to a banquet in his mansion at the end of every winter term. All the students show up, not so much for the anecdotes the Dean shares with the attendants, but for the free beer and, above all, to see the beautiful daughters of the Dean.

Since the number of female computer science students is negligible, as is the number of male ones with girlfriends (we're talking about a nerdy subject after all), it is fair to say that every student attending the banquet has made up his mind about the daughters. There are two types of students:

Lovers: A lover is a student that has a crush on exactly one of the daughters.

Haters: A hater is a student that, the bitter and spoiled person he is, rages about how much of a stupid *lady*[1] a certain daughter is.

Standing in a queue in front of the Dean's house waiting for the Dean to let them in, every student is chatting with the student directly in front and directly behind him. Though computer science students tend to be peaceful in general, in case a hater and a lover with respect to the same daughter stand next to each other, they see no choice but to settle their dispute like real men: Go home and meet on a neutral server to fight Counter Strike one on one, until both of them realize that gaming is better than girls anyway. Whenever two students wander off this way, the adjacent students close the gap and continue to chat.

The Dean wants to set the table and therefore needs to know how many students will be attending his banquet, that is, how many people will be waiting in front of the house when he opens the door.

8.2 Input

The first line of the input contains an integer denoting the number of test cases c that follow ($0 \leq c \leq 100000$). Each test case consists of one line containing the number of students n in the queue ($0 \leq n \leq 100000$) and n integers $s_i \in \{-127, -126, \ldots 127\} \setminus \{0\}$ describing each student ($1 \leq i \leq n$).

A positive number means the student is a lover, a negative number means the student is a hater. The absolute value denotes the daughter (for some ordering of the daughters).

8.3 Output

For each test case, output the number of students that will be left in the queue once all

[1] redacted

conflicts of neighbouring students have been resolved on a separate line.

8.4 Sample input

```
5
6 1 2 3 -3 4 5
10 -1 -2 -3 -4 -5 5 4 3 2 1
3 1 1 1
0
9 5 4 -4 4 6 7 -6 -7 1
```

8.5 Sample output

```
4
0
3
0
7
```

9 Sum2D

9.1 Problem

You are given a rectangular field of integers with a width W and a height H. These integers are all in the range [-1000,1000]. Your task is to write a programm that computes the sum of all integers in a rectangular subfield. You are therefore additionally given a list of Q subrectangles. For each of these subrectangles you should compute the sum.

9.2 Input

The first line contains W, H and Q in that order.

The next H lines contain each W integers seperated by a space. This is the rectangular field.

After that another Q lines follow with 4 integers x_1, y_1, x_2, y_2 in that order. (x_1, y_1) and (x_2, y_2) form two opposing edges of a subrectangle. Coordinates are in the range [1,W] or [1,H]. The edges should be included in the subrectangle.

H and W will not exceed 1000.

9.3 Output

For each subrectangle print the sum of the integers in it on a line of its own.

9.4 Sample input

```
5 4 3
1 5 -3 8 -4
2 4 -1 -5 9
10 1 0 -8 5
3 5 9 0 1
1 1 5 4
2 3 2 3
4 3 2 2
```

9.5 Sample output

```
42
1
-9
```

10 Zero, One, Two, Buckle My Shoe

10.1 Problem

Among kids, a popular way to pick a person (seemingly) at random is to use a counting rhyme. Joseph is a smart kid and noticed that he can use counting rhymes to his advantage by always choosing counting rhymes that produce the result he wants. His remarkable skill in that matter is best illustrated by the following anecdote:

> *Joseph was playing football*[2] *with his $k-1$ friends when another group of k kids showed up who wanted to play as well. Since the lawn was small, at most k kids could play simultaneously and they needed to decide which k kids could stay and which k kids had to go home. They therefore lined up in a circle, first Joseph's friends, then the other kids and repeatedly used a counting rhyme to pick the kids that had to go home, each time carrying on with the counting where they stopped. Joseph was the one that proposed the counting rhyme and—lo and behold!—all of the newcomers and none of his friends were picked to go home.*

You should find the minimum amount of syllables, depending on k, that will produce this result.

For example if k is 3 the answer is 5 syllables, because this way the 5th, 4th and 6th kid will be picked (in this order) and the 1st, 2nd and 3rd can stay. No number smaller than 5 produces this result.

10.2 Input

The first line of the input contains an integer denoting the number of test cases c that follow ($0 \leq c \leq 100000$).

For each test case there will be a line containing k where $0 < k < 14$.

10.3 Output

For each test case output the minimum number of syllables needed on a separate line.

10.4 Sample input

```
2
3
4
```

[2] This is a British problem description, so we are talking about actual football not about *American-carry-the-egg-with-your-hands-ball.*

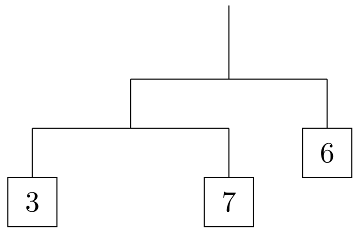
10.5 Sample output

```
5
30
```

11 Equilibrium Mobile

11.1 Problem

A mobile is a type of kinetic sculpture constructed to take advantage of the principle of equilibrium. It consists of a number of rods from which weighted objects or further rods hang. The objects hanging from the rods balance each other so that the rods remain more or less horizontal. Each rod hangs from only one string, which gives it freedom to rotate about the string. Rods have no weight. We consider mobiles where each rod is attached to its string exactly in the middle, as in the figure below. You are given such a configuration, but the weights on the ends are chosen incorrectly, i.e. the mobile is not in equilibrium. Since that's not aesthetically pleasing, you decide to change some of the weights.



The mobile from the first sample input.

What is the minimum number of weights that you must change in order to bring the mobile to equilibrium? You may substitute any weight by any (arbitrarily heavy and possibly non-integer) weight. For the mobile shown in the figure, equilibrium can be reached by changing the middle weight from 7 to 3, so only 1 weight needs to be changed.

11.2 Input

On the first line one positive number: the number of test cases, at most 100, followed by a blank line. After that per test case:

- One line containing l, the number of lines following, $1 \leq l \leq 16$, followed by a line break.
- The i-th following line (counting from 0) contains 2^i integers, separated by spaces, describing the situation on the i-th level. For the j-th entry in the line, the object above is in the previous line at position $\lfloor \frac{j}{2} \rfloor$, and the two objects below in the following line at positions $2j$ and $2j+1$. Each value has one of the following meanings:
  - 0 means there is a rod at this position, and the $2j$-th and $2j+1$-th entries of the next lines are attached to it at the left and right respectively.
  - n for some positive n, $1 \leq n \leq 2^{13}$, means there is an object of weight n at

this position. There cannot be anything but −1 below it.

  - −1 means that there is nothing at this position, because there's either nothing or a weight above. There cannot be anything but −1 below it.

Each test case is followed by a blank line.

11.3 Output

Per test case:

- One line with the minimum number of weights that have to be changed, followed by a line break.

11.4 Sample input

```
4

3
0
0 6
3 7 -1 -1

1
40

3
0
0 0
2 3 4 5

4
0
20 0
-1 -1 10 0
-1 -1 -1 -1 -1 -1 5 3

```

11.5 Sample output

```
1
0
3
1
```