WOBURN CHALLENGE

2015-16 Online Round 3

Friday, February 12th, 2016

Junior Division Problems

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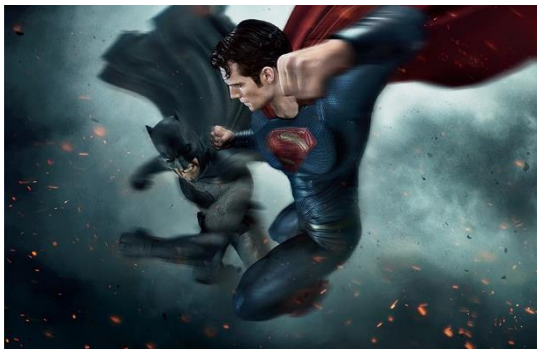
Problem J1: Battle Predictions

10 Points / Time Limit: 2.00s / Memory Limit: 16M *Submit online: wcipeg.com/problem/wc153j1*



What is a savior but an emblem of hope – but a monument for the people to look up to? Should he be anything that the world needs him to be – or should he be none of it? What does a savior owe the world?

The time has come for the man of steel to finally face these difficult questions. Meanwhile, feelings of fever, rage and powerlessness are festering within the dark knight of Gotham. He can do nothing but watch as the planet praise an alien capable of annihilating it. The peace of Gotham he fought so long to protect is now compromised by a godly figure that has unworthily gained the world's reverence.

To take care of this threat for good, the masked billionaire will have to elaborate a plan like no other he's ever concocted. In particular, Batman plans to use Kryptonite-based weapons and a heavily-armored mech suit to defeat the most powerful being on Earth. The success of the battle is hugely dependent on the strength/purity of the Kryptonite weapons as well as the durability of the mech suit. He has aggregated the attack power provided by his weapons and the defense power provided by his suit into two ratings A_B and D_B respectively. Being a master detective, Batman has also carefully scrutinized Superman's strength and techniques from past battles. Through this, he has aggregated Superman's attack power and defense power into two ratings A_S and D_S respectively. Each of these four ratings is a positive integer no greater than 100.

Clearly, Batman will emerge victoriously if his attack power is *strictly greater* than Superman's defense power, and his defense power is strictly greater than Superman's attack power. On the other hand, Superman will prevail if his attack power is strictly greater than Batman's defense, and his defense is also strictly greater than Batman's attack. If neither of these situations occur, then unfortunately it will be unclear who will win, so the outcome will be difficult to predict.

Batman is the type of hero who needs contingency plans for his contingency plans, so there's no way he'll be willing to enter the fight with surprises. Can you help him predict the results of the upcoming battle or determine that it's inconclusive so Batman knows he must further prepare?

Input Format

The first line will contain the two space-separated integers A_B and D_B.
The second line will contain the two space-separated integers A_S and D_S.

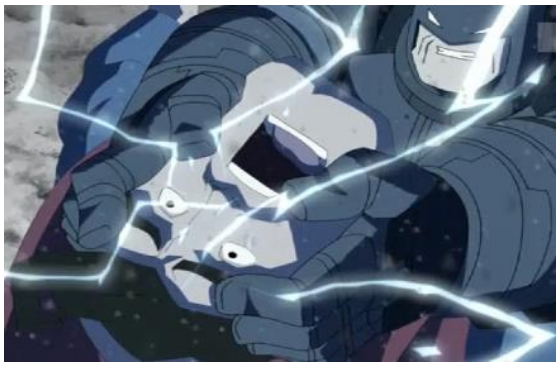
Output Format

Output on a single line the result of the showdown – `Batman` if Batman will win, `Superman` if Superman will win, or `Inconclusive` otherwise.

Sample Input 1	Sample Output 1	Sample Input 2	Sample Output 2	Sample Input 3	Sample Output 3
12 31 100 60	Superman	1 4 2 3	Inconclusive	50 51 50 50	Inconclusive

Problem J2: Electroshock Therapy

20 Points / Time Limit: 2.00s / Memory Limit: 16M *Submit online: wcipeg.com/problem/wc153j2*



Having found the battle predictions to be inconclusive, Batman has decided to employ another powerful weapon to guarantee his victory against Superman – electricity! After all, the man of steel should be a good conductor.

Although Batman is a genius-level physicist, it doesn't take a genius to know that a stupendous amount of energy is required to bring down a being who draws his power from the sun. Clearly, the quantity of energy to weaken Superman is too massive to be stored and carried around in the Batmobile. Through a stroke of brilliancy, he realized that he could simply tap into the city's power grid. So his plan is as follows: Batman will engineer his mech-suit to conduct electricity without doing any harm to himself, the wearer. When the time is right, Batman will plug the suit into any point in the power grid that he will have hooked up before the battle. Then, he will grip both hands onto Superman's body (closing the circuit) and direct an immense wave of electricity through the man of steel.

The challenge of this plan is all in the preparation: properly wiring up the city's power grid to the street on which the battle will take place. Batman already knows the location of the battle, and he knows that on that street, there are N ($1 \le N \le 500$) adjacent buildings numbered from 1 to N. The i-th building (for $i = 1..N$) has a total of H_i ($1 \le H_i \le 500$) floors. From inspecting a map of the city's power system, Batman noticed that he will need to wire up every building on the street to maximize his power output. To make his circuit as resilient as possible, he has decided to also wire up every floor on each building to the same floors of adjacent buildings (if they exist). This way, if the connection breaks in any one building, the circuit is still quite likely to be connected. Wires will run horizontally along the top of buildings, vertically across the sides of buildings, as well as horizontally across each floor of each building. However, the same floor across two adjacent buildings will share a vertical wire.

For example, if there are $N = 4$ buildings with heights $H = \{2, 1, 3, 2\}$, his circuit should look as follows:

```
   _
 _  |_|_
|_|_|_|_|
|_|_|_|_|
```

Each horizontal and vertical unit of wiring will require the same length of wire. For example, the above structure will require 24 units of wire. Batman may be a billionaire, but you don't stay rich by wasting money. Thus, he would like to use the minimum amount of wiring to create his weapon. Can you help him determine the length required?

Input Format

The first line will contain a single integer N. The next line will contain N space-separated integers, the values of H_1 through H_N.

Output Format

Output a single integer, the length of wires required to build the circuit, in units.

Sample Input

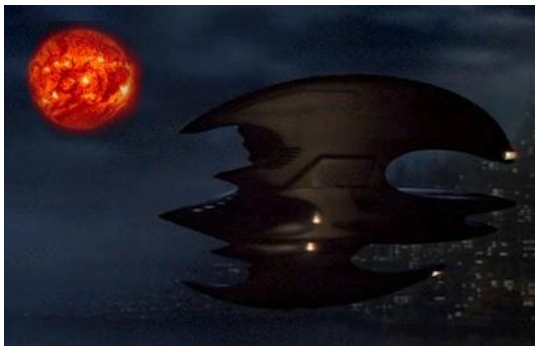
```
4
2 1 3 2
```

Sample Output

```
24
```

Problem J3: Red Sun Simulator

30 Points / Time Limit: 2.00s / Memory Limit: 16M *Submit online: wcipeg.com/problem/wc153j3*



Being a masterful tactician, Batman wants to take advantage of his opponent's every weakness in battle. Too bad there just aren't many weaknesses of Superman. Though Superman's most famous weakness is Kryptonite, Batman's Kryptonite-laced weapons may still not be enough to help him win. A lesser known weakness of Super is the red sun. The red sun on Krypton is much less radiant than the yellow sun on Earth, which is why native Kryptonians aren't naturally as strong as Superman. It is only because Superman grew up on Earth that his powers are acquainted to and magnified by our powerful yellow sun's radiation.

Without a yellow sun, Superman's powers will be temporarily weakened. Even for Batman, it is quite near impossible to block out yellow sun radiation altogether. However, Batman believes that if he is able to temporarily convert the yellow sun radiation to red sun radiation, then he will be able to weaken Superman to the same effects. With the help of Lucius Fox, WayneTech was able to secretly develop a device to perform this exact conversion. This sophisticated technology, known as the Red Sun Simulator (RSS) will be installed onto the batplane which will idle in the sky during their fight. When the time is right, the device will continuously diffuse electromagnetic waves that will create an interference pattern with the electromagnetic radiation of the sun. The radiation generated by the RSS should be at precise frequencies so that the resulting wave exactly matches the frequency of the red sun of Krypton. Unfortunately for Batman, the frequency of solar radiation is going to be constantly changing due to small factors such as atmospheric conditions and their altitude. Due to these constraints, the ability of the RSS to produce waves at a certain frequency will also be limited.

The masterful tactician he is, Batman has planned out how every moment of the battle is going to go down. In particular, he predicts that there will be N ($1 \le N \le 50000$) minutes in the entire battle. During the i-th minute, the frequency of the solar radiation is forecasted to be F_i ($1 \le F_i \le 10^9$) megahertz. In order for Superman to be weakened by red sun radiation during minute i, the frequency produced by the RSS must be a *multiple* of the solar frequency during that minute. In minute i, the RSS will randomly produce a frequency from a set of M_i ($1 \le M_i \le 5$) intervals. The j-th of these intervals will consist of the integers from $A_{i,j}$ to $B_{i,j}$ ($1 \le A_{i,j} \le B_{i,j} \le 10^9$) inclusive, meaning that during minute i, the RSS is capable of emitting radiation at any one frequency from $A_{i,j}$ megahertz to $B_{i,j}$ megahertz for any j from 1 to M_i. For each minute i, the M_i intervals will be non-overlapping, meaning that any integer will be part of at most one of the intervals.

Batman is interested in whether he can weaken Superman for a particular number of minutes in total. Thusly, he wants to answer Q ($1 \le Q \le N + 1$) questions, where the i-th question is: "is it at all possible to weaken Superman during exactly T_i minutes of the total N minutes of the battle?" ($0 \le T_i \le N$). Please write a program to analyze the solar data and answer Batman's queries.

In cases worth 20/30 of the points, $F_i \le 100$ and $B_{i,j} \le 100$.
In a subset of those cases worth 10/30 of the points, $N \le 8$.

Input Format

The first line will contain two space-separated integers N and Q. The next N lines will each start with 2 space-separated integers F_i and M_i, followed by M_i space-separated pairs of integers $A_{i,j}$ and $B_{i,j}$ (for $i = 1..N$ and $j = 1..M_i$). The last Q lines will each contain a single integer T_i (for $i = 1..Q$).

Output Format

Q lines with one character per line. The *i*-th of these lines is "`Y`" if Batman can weaken Superman using simulated red sun radiation during exactly T_i minutes, or "`N`" otherwise.

Sample Input

```
4 3
10 3 23 27 1 5 109 110
5 2 7 9 41 42
5 2 7 9 40 42
100 1 100 100
0
2
4
```

Sample Output

```
N
Y
N
```

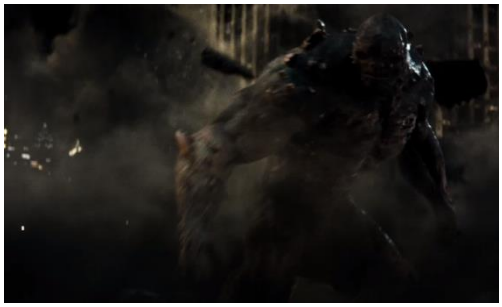
Explanation

Batman predicts the battle to last a measly 4 minutes. It's impossible for Batman to weaken Superman for 0 minutes, since he'll always be emitting the appropriate frequency to produce red sun radiation the last round (the RSS radiation is fixed at 100 MHz during that minute, which is a multiple of the solar radiation of 100 MHz). It's also impossible for him to weaken Superman in all 4 minutes, since there's no way he can produce red sun radiation in the second minute (the RSS cannot possibly emit a frequency which is a multiple of 5 MHz). However, there are various ways in which Superman can be weakened for exactly 2 minutes, such as if the following frequencies happen to be emitted by the RSS:

- 1st minute: 110 MHz (producing red sun radiation when interfered with the sun's 10 MHz)
- 2nd minute: 8 MHz (not producing red sun radiation when interfered with the sun's 5 MHz)
- 3rd minute: 42 MHz (not producing red sun radiation when interfered with the sun's 5 MHz)
- 4th minute: 100 MHz (producing red sun radiation when interfered with the sun's 100 MHz)

Problem J4: LexCorp Infiltration

40 Points / Time Limit: 1.00s / Memory Limit: 64M *Submit online: wcipeg.com/problem/wc153j4*



While the dust settles in the battle between the dark knight and the last son of Krypton, the two have suddenly come to recognize the true mastermind behind it all. After General Zod's invasion on Earth, LexCorp was contracted by the U.S. government to carefully reverse-engineer leftover Kryptonian technology. As it turns out, the battle between the heroes had simply been Lex Luthor's test in his greater conspiracy to craft a powerful biotechnological weapon against Superman. At that point, it became clear to both that the world is in much graver danger than ever before. Luthor's international masquerade as a humanitarian has attracted the attention of Princess Diana of Themyscira, also known as Wonder Woman. After joining forces with Superman and Batman, the trio obtain intel of Luthor's dangerous bio-weapon project – Doomsday.

But it's too late. To destroy the reputation of Superman, Doomsday has already been deployed by Luthor and is wreaking havoc and causing wanton destruction upon Metropolis. Doomsday was originally a deadly monster born from the depths of ancient Krypton. As Luthor has reanimated the abominable legend from his own laboratories on Earth, Doomsday is actually being puppeted from the very control rooms in LexCorp Tower. To stop this vicious foe, Wonder Woman will have to infiltrate LexCorp Tower and use Batman's knockout gas to shut down these control rooms one at a time.

Using his X-Ray vision, Superman has helped devise a map of the control floor of LexCorp Tower. He knows that the floor can be represented as a rectangular grid of R rows and C columns ($1 \le R, C \le 1000$). The rows are numbered $1..R$ from north to south, while the columns are numbered $1..C$ from west to east. The j-th cell in the i-th row can be referred to as cell (i, j). Each cell (i, j) is either part of a control room or a wall, which is indicated by the value of character $M_{i,j}$ on the map (with "`.`" indicating it is part of a control room and "#" indicating it is a wall). At least one cell will be part of a control room.

The control floor will obviously consist of some number control rooms (at least one), where each control room on the map consists of a consecutive region of "`.`" characters. More formally, every "`.`" cell is part of exactly one control room, and if a pair of "`.`" cells are adjacent to one another, then they must be part of the same control room. Two cells (i_1, j_1) and (i_2, j_2) are adjacent if and only if $|i_1 - i_2| + |j_1 - j_2| = 1$ (in other words, if they share a side). The size of a control room is the number of "`.`" cells that are part of it.

Releasing knockout gas in a given room will knock out of all its controlpersons, permanently preventing the room from conveying a particular type of vital information to Doomsday's operations. Since Doomsday is already terrorizing Metropolis at a substantial rate, the order in which Wonder Woman infiltrates the rooms is vital in minimizing damage done to the city. Since it's likely that larger control rooms convey more important information, assigning ranks to rooms based on their size may help Wonder Woman workout her plan. At any time during the mission, the rank of control room r is an integer equal to the number of active control rooms whose sizes are strictly larger than control room r's size.

All that said, N ($1 \le N \le 3000$) events will take place in the mission, one after another. Each event i concerns a "`.`" cell (A_i, B_i) ($1 \le A_i \le R$, $1 \le B_i \le C$), and can be of one of 2 types, indicated by the value T_i ($1 \le T_i \le 2$):

1. Wonder Woman assesses the situation of the control room that cell (A_i, B_i) is part of.
2. Wonder Woman travels to cell (A_i, B_i) and gasses the entire control room containing that cell.

To make her mission smooth, she has asked you to help her write a program to keep track of her progress. Right before each event i takes place, your program should determine the current rank of the control room containing cell (A_i, B_i) and output it. However, if that cell belongs to a control room that she has already gassed (in one of the first $i - 1$ events), you should instead output `-1` to remind her. When a control room is gassed, it ceases to convey signals to Doomsday, meaning that the ranks of other control rooms may change. On the other hand, gassing an already gassed room has no effect. Superman's reputation is dwindling with every moment of Metropolis's destruction, so you'd better code fast!

In test cases worth 20/40 of the points, there will be no type-2 events.

Input Format

The first line of input will contain three space-separated integers R, C, and N.
The next R lines will each contain C characters $M_{i,1}, M_{i,2}, \ldots, M_{i,C}$, for $i = 1..R$.
The next N lines will each contain three space-separated integers T_i, A_i, and B_i, for $i = 1..N$.

Output Format

Output N lines with a single integer per line. Line i should contain the rank of the control room of the cell targeted by the i-th event (or `-1` if the room has already been previously gassed), for $i = 1..N$.

Sample Input

```
5 6 5
..#.#.
..####
.#..##
#..##.
..###.
1 1 4
1 3 4
2 1 2
2 3 1
1 1 4
```

Sample Output

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

Explanation

There are 5 control rooms. The largest one (the one that includes the south-west cell) has size 6, so its rank is 0. The two size-1 rooms near the top right of the map both have rank 3. If we label each control room cell with the rank of its control room, the map initially looks as follows:

```
11#3#3
11####
1#00##
#00##2
00###2
```

The 3rd event causes the north-west control room to be gassed, leaving the map looking as follows:

```
**#2#2
**####
*#00##
#00##1
00###1
```