WOBURN CHALLENGE

2016-17 Online Round 2

Sunday, December 11th, 2016

Junior Division Problems

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Problem J1: The Perfect Mate

10 Points / Time Limit: 2.00s / Memory Limit: 16M *Submit online: wcipeg.com/problem/wc162j1*

Lieutenant B'Elenne Terres is one unsatisfied Klingon. Her engineering working aboard the Starship Enterprise is all well and good, but what she really needs is a mate!

Fortunately for her, the Enterprise has happened across a Klingon colony, which has N ($1 \le N \le 100$) warriors living there. The i-th warrior's name is S_i (a unique string consisting of at most 20 letters), and according to a survey which Terres has conducted, they've won W_i ($0 \le W_i \le 100$) battles and lost L_i ($0 \le L_i \le 100$) battles in their lifetime. She's not too concerned about which of the warriors actually happen to be single at the time.

Any warrior who has lost at least one battle would clearly not make a suitable mate – weakness is unacceptable. Of the warriors who have never lost any battles, the perfect mate is the one who has won the greatest number of battles. If multiple suitable warriors have won the same number of battles, then the one earliest in the list of N warriors is preferable.

Please help Terres determine the name of this perfect mate! Of course, it's also possible that there's no such mate, if none of the N warriors are suitable.

Input Format

The first line of input consists of a single integer N.
N lines follow, with the i-th of these lines consisting of a single string S_i, followed by a space, followed by two space-separated integers W_i and L_i (for $i = 1..N$).

Output Format

Output a single line consisting of a single string – either the name of the perfect mate, or "`None`" if there are no suitable mates.

Sample Input 1

```
5
Mereg 7 0
Werf 15 10
Kehless 14 0
Kerek 14 0
Stex 2 3
```

Sample Output 1

```
Kehless
```

Sample Input 2

```
1
Jacob 100 1
```

Sample Output 2

```
None
```

Problem J2: EHC

20 Points / Time Limit: 3.00s / Memory Limit: 64M *Submit online: wcipeg.com/problem/wc162j2*

"Please state the nature of the culinary emergency!" exclaims the Enterprise's EHC (Emergency Holographic Chef), having just been activated. It seems that Lieutenant Commander Le Ferge is extremely hungry, and will need to be brought a hot meal, stat!

The EHC is currently in the mess hall, and will need to make his way to the bridge to save Le Ferge. The bridge is at the end of a hallway, which is M ($1 \le M \le 10^9$) metres long. There's just one complication – being a hologram, the EHC must remain within a distance of R ($1 \le R \le 10^9$) metres (inclusive) of a holographic emitter at all times.

Fortunately, there's a holographic emitter installed right at the entrance to the mess hall, and there are N ($0 \le N \le 200{,}000$) other emitters located at various points along the hallway. The i-th of these emitters is E_i ($1 \le E_i < M$) metres away from the mess hall (and thus, $M - E_i$ metres away from the bridge). No two emitters are in the same location.

The existing set of $N + 1$ holographic emitters may not provide enough unbroken coverage for the EHC to be able to successfully walk from the mess hall to the bridge. If that's the case, some more emitters may need to be installed along the hallway, at any chosen locations.

Le Ferge is very, very hungry, and only the EHC is qualified enough to feed him! Given that time is of the essence, what's the minimum number of additional holographic emitters which must be installed in order for every point in the hallway to be at most R metres away from at least one emitter?

In test cases worth 8/20 of the points, $N \le 2000$ and $M \le 2000$.
In test cases worth another 8/20 of the points, $N \le 2000$.

Input Format

The first line of input consists of three space-separated integers N, M, and R.
N lines follow, with the i-th of these lines consisting of a single integer E_i (for $i = 1..N$).

Output Format

Output a single integer – the minimum number of additional emitters required.

Sample Input

```
2 100 15
85
61
```

Sample Output

```
2
```

Explanation

One possibility is to place two holographic emitters 30 metres and 40 metres away from the mess hall. If only the first of these emitters is added, then the EHC won't be able to traverse the section of the hallway between 45 and 46 metres from the mess hall (exclusive).

Problem J3: Most Illogical

30 Points / Time Limit: 2.00s / Memory Limit: 16M *Submit online: wcipeg.com/problem/wc162s1*

Mr. Speck, the Vulcan chief engineer aboard the Starship Enterprise, has grown tired of his crewmates' illogical tendencies. He's found that, not only is the veracity of their statements often questionable, they sometimes even make claims which are objectively false! He'd like to ascertain the truth of some statements made by his colleagues in order to set them straight.

Mr. Speck has modeled a certain statement made by one of his crewmates as a Boolean expression, consisting of a sequence of N ($3 \le N \le 99$, N is odd) strings. Starting from the first string, every other string is a Boolean literal representing the veracity of a particular claim, which is either "`true`", "`false`", or "`unknown`". Starting from the second string, every other string is a Boolean operator, either "`or`" or "`and`".

Order of operations applies to this expression, with "`and`" having higher precedence than "`or`". For example, the expression "`false or true and false`" evaluates to "`false or (true and false)`" = "`false or false`" = "`false`".

Mr. Speck is interested in the accuracy of the entire statement - that is, the value of the whole Boolean expression. If every Boolean literal within it was known to be either "`true`" or "`false`", then the expression could be evaluated to similarly be either "`true`" or "`false`". However, each "`unknown`" literal may independently be either "`true`" or "`false`", which may cause the expression's value to be uncertain. If the expression can either evaluate to "`true`" or "`false`" depending on the actual values of its "`unknown`" literals, then the expression's value is considered to also be "`unknown`". Please help Mr. Speck determine the value of the Boolean expression, so that he may reprimand his crewmate accordingly!

In test cases worth 6/30 of the points, all of the operators will be "`or`".
In test cases worth another 6/30 of the points, all of the operators will be "`and`".
In test cases worth another 6/30 of the points, none of the Boolean literals will be "`unknown`".

Input Format

The first line of input consists of a single integer N.
The second line consists of N space-separated strings representing the Boolean expression.

Output Format

Output a single line consisting of a single string representing the result of the Boolean expression.

Sample Input 1

```
3
true or false
```

Sample Output 1

```
true
```

Sample Input 2

```
3
unknown and false
```

Sample Output 2

```
false
```

Sample Input 3

```
5
false or true and unknown
```

Sample Output 3

```
unknown
```

Problem J4: Away Mission

40 Points / Time Limit: 3.00s / Memory Limit: 64M *Submit online: wcipeg.com/problem/wc162s2*

During its travels, the Starship Enterprise has come across a rather curious planet which appears to be contain vast deposits of kironide, a rare and valuable mineral. Captain Kerk has ordered N ($1 \le N \le 200{,}000$) of his crewmembers to go on an away mission to the planet's surface in order to confirm the sensors' readings. If all goes well, they'll be able to locate the kironide and collect some samples… before anything on the planet collects *them* as samples.

Each of the N crewmembers will need to be outfitted with a shirt, of course. It's standard Starfleet procedure for shirts to be manufactured on demand, with the use of a shirt replicator. The replicator is fed three Colour Component Chips (CCCs) – a red, green, and blue one – which determine the colour of the resulting shirt. Each CCC, in addition to corresponding to a particular colour component (either red, green, or blue), is encoded with an integral value between 0 and 255, inclusive. Kerk has N red CCCs with values $R_{1..N}$ at his disposal. He similarly has N green CCCs with values $G_{1..N}$, and N blue CCCs with values $B_{1..N}$.

Kerk may feed the CCCs into the shirt replicator in any combinations he'd like to in order to create N shirts, as long as the replicator is always given CCCs corresponding to all three different colour components at a time, and each of the $3N$ CCCs is only used once.

A shirt is considered "red" if its red CCC's value is strictly larger than its other two CCCs' values. In other words, if a shirt was produced using red, green, and blue CCCs with values r, g, and b, then it's red if both $r > g$ and $r > b$.

Unfortunate accidents have a way of happening to crewmembers wearing red shirts, so producing as few red shirts as possible would be beneficial. However, a strange anomaly has recently struck the Enterprise, which may be having unusual psychological effects on its crew, based on the value of Q ($1 \le Q \le 2$). If $Q = 1$, then Kerk has remained resilient and is determined to arrange his CCCs such that as few as possible of the N shirts are red. Otherwise, if $Q = 2$, then Kerk's psychological state has been compromised, and he'll instead maximize the number of red shirts produced!

In either case, please help estimate the number of "accidents" which might occur on the away mission by determining how many of the crewmembers will end up wearing red shirts.

In test cases worth 8/40 of the points, $N \le 2000$ and $B_i = 0$ for $i = 1..N$ (and in exactly 50% of these, $Q = 1$).
In test cases worth another 16/40 of the points, $N \le 2000$ (and in exactly 50% of these, $Q = 1$).
In exactly 50% of the remaining test cases, $Q = 1$.

Input Format

The first line of input consists of two space-separated integers N and Q.
The next line consists of N space-separated integers $R_{1..N}$.
The next line consists of N space-separated integers $G_{1..N}$.
The next line consists of N space-separated integers $B_{1..N}$.

Output Format

Output a single integer – either the minimum possible number of red shirts that must be made if $Q = 1$, or the maximum possible number that can be made if $Q = 2$.

Sample Input 1

```
3 1
200 0 123
0 42 122
5 200 99
```

Sample Output 1

```
1
```

Explanation 1

One optimal set of shirts is as follows (with each one notated as (r, g, b)):

```
(200, 0, 200)
(0, 42, 99)
(123, 122, 5)
```

Of these, only the last one is red. Unfortunately, it's impossible for none of the shirts to be red.

Sample Input 2

```
3 2
200 0 123
0 42 122
5 200 99
```

Sample Output 2

```
2
```

Explanation 2

One optimal set of shirts is as follows:

```
(200, 0, 99)
(0, 42, 200)
(123, 122, 5)
```