

Exercise – *Hermione Granger*

“Draco, Draco, you are not a killer.” “How do you know?” said Malfoy at once. He seemed to realise how childish the words had sounded; Harry saw him flush in the Mark’s greenish light. “You don’t know what I’m capable of,” said Malfoy more forcefully. “You don’t know what I’ve done!”

Harry Potter and the Half-Blood Prince *by J. K. Rowling*

Draco Malfoy, Vincent Crabbe, and Gregory Goyle are up to something evil; Harry Potter is sure of it. Ever since spotting Malfoy with a dealer of sinister objects, Harry has tried to spy on this gang of three throughout the school year. However, they can somehow disappear so mysteriously that Harry could not even find them on the *Marauders’ Map*, which can locate everyone else at Hogwarts with no problem. Even worse, Headmaster Dumbledore wants to go on a trip with Harry in 24 hours. That means Malfoy and his friends will soon have a clear shot to carry out their evil deed, whatever it is. Harry has to find them fast and disrupt them.

Harry’s idea is to use the bottle of *Felix Felicis* he has won in a Potions class. This potion grants a time period of luck, proportional to the amount consumed and with varying intensity between individuals. It induces intuitions that can guide the drinker towards achieving her wishes. It is not easy to predict its effect precisely and hence, many assumptions will need to be made. Harry hopes that his know-it-all friend, Hermione Granger, can lend a hand.

Hermione believes that the students of Slytherin House will have some clues about Malfoy, Crabbe, and Goyle’s whereabouts. But one student alone may not have enough information, so it is best to query many. Therefore, it is time to enlist the help of *Dumbledore’s Army* (DA), a secret students’ club that Harry led last year. Hermione plans to divide the bottle of Felix Felicis among the DA members. She assumes that during the hours of luck granted by the potion, each DA member will be guided toward the closest Slytherin student, who she assumes to be unique. Until the effect of the potion wears off, the Slytherin student is interrogated and simultaneously leaks a different amount of information per hour about the locations of Malfoy, Crabbe, and Goyle. For each of the three trouble makers, Hermione also estimates the amount of information needed to locate them.

Using the Marauder’s Map, Hermione can locate all the DA members and the Slytherin students in order to come up with a suitable allocation of Felix Felicis. The map also helps Harry to sneak around Hogwarts and deliver the allotted portions of the potion. The DA members have enchanted gold coins that can be used to receive instruction from Hermione and send back the information that they gather. We assume that the time it takes for Harry to distribute the potion and for each DA member to get to her closest Slytherin student is negligible.

Will Harry be able to locate Malfoy’s gang before his trip with Dumbledore in 24 hours or will they remain hidden?

Input The first line of the input contains the number $t \leq 100$ of test cases. Each of the t test cases is described as follows.

- It starts with a line that contains four integers $f \ m \ c \ g$, separated by a space and such that $0 \leq f, m, c, g \leq 2^{24}$. Here f denotes the amount of Felix Felicis (in ml), and the

triple (m, c, g) denotes how much information must at least be gathered by all the DA members together to locate Malfoy, Crabbe, and Goyle, respectively.

- The following line contains two integers d s , separated by a space and such that $1 \leq d \leq 4'000$ and $1 \leq s \leq 9 \cdot 10^4$. Here d denotes the number of DA members and s denotes the number of Slytherin students.
- The following s lines define the Slytherin students. Each line contains five integers x_i y_i m_i c_i g_i , separated by a space and such that $|x_i|, |y_i| < 2^{24}$ and $0 \leq m_i, c_i, g_i \leq 2^{10}$. In this way, (x_i, y_i) describes the location of the i -th Slytherin student and (m_i, c_i, g_i) describes the information she leaks per hour about the three respective trouble makers.
- The final d lines define the DA members. Each line contains three integers x_j y_j f_j , separated by a space and such that $|x_j|, |y_j| < 2^{24}$ and $1 \leq f_j \leq 2^{10}$. In this way, (x_j, y_j) describes the location of the j -th DA member and f_j describes how much Felix Felicis (in ml) she needs to get one hour of luck. For instance, if she drinks $1.5f_j$ ml of Felix Felicis, then she gets 1.5 hours of luck.

Output For each test case output a line with one single character: “L” or “H”. The character is “L” if Hermione can come up with an allocation of Felix Felicis such that the DA members can gather enough information in time to locate Malfoy, Crabbe, and Goyle. Otherwise, the gang remains hidden and the output character is “H”.

Points There are three groups of test sets. For each group there is also a corresponding hidden test set. Overall, you can achieve 100 points.

1. For the first group of test sets, worth 30 points, and for the corresponding hidden test set, worth 5 points, you may assume that $s \leq 4'000$ and each Slytherin student leaks the same amount of information about every trouble maker, that is $m_i = c_i = g_i$, for all i .
2. For the second group of test sets, worth 30 points, and for the corresponding hidden test set, worth 5 points, you may assume that $s \leq 4'000$.
3. For the third group of test sets, worth 20 points, and for the corresponding hidden test set, worth 10 points, there are no additional assumptions.

Corresponding sample test sets are contained in `testi.in/out`, for $i \in \{1, 2, 3\}$.

Sample Input

```
3
26 24 24 24
1 1
0 0 1 1 1
2 0 1
26 24 24 25
2 1
0 0 1 1 1
-1 0 2
2 0 1
26 24 24 24
1 2
0 0 1 1 1
3 0 1 1 0
2 0 1
```

Sample Output

```
L
H
H
```