

## Exercise – *Dean Thomas*

It had been a nightmarish experience, seeing the Dementors gliding out of the mist in the distance and realising, as the paralysing cold choked his lungs and a distant screaming filled his ears, that he was not going to be able to protect himself.

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Harry Potter and the Deathly Hallows by J. K. Rowling

Dean Thomas's carefree days were long gone, when the Ministry of Magic began to persecute Muggle-borns<sup>1</sup> for allegedly stealing magic from rightful wizards. Even worse, Voldemort's influence had reached Hogwarts, and the school was no longer a safe haven. Unable to prove his wizarding ancestry, Dean had no choice but to join the countless Muggle-borns on the run.

On a misty afternoon, Dean and a few other fugitives find themselves scattered over a Welsh countryside. Suddenly, a chill sweeps through them, as they realize the presence of Dementors around the area. Previously confined to the wizarding prison Azkaban, these foul creatures are now on the loose all over the country. They feed on human happiness, hope, and peace. Whenever a Dementor is near, everyone experiences a cold feeling of darkness and despair, although the effect varies from person to person depending on how much terror they have witnessed in the past. The fugitives promptly cast the Patronus charm, which summons a spectral guardian to limit the Dementors' effect. However, the charm will not last long and will certainly go away when the fugitives fall asleep. Therefore, everyone must find a safe spot to spend the night.

Because of the mist, the Dementors cannot be tracked at all times. But it is known that they tend to patrol a certain region, which expands at night when they are most active. Let  $\ell$  be the position where a given Dementor was last observed. The fugitives operate under the assumption that the Dementor stays within distance at most  $d$  from  $\ell$  during daytime, and that this maximum roaming distance increases to  $2d$  at night.

Even with their Patronuses, the fugitives need to stay away from the Dementors in order to avoid their despairing effect. Let  $p_i$  denote any fugitive. During daytime, with their Patronus around, person  $p_i$  is safe when they are at distance at least  $s_i$  from any potential Dementor location. At night, without the Patronus, the minimum safe distance increases to  $2s_i$ .

Which of the fugitives can find a safe spot to spend the night? A safe spot for a person can be their initial location or another point that they can move to from their initial location with their Patronus during daytime. However, while moving and throughout the night, the person must always stay at a safe distance from any potential Dementor location. Any number of people can use the same safe spot.

**Input** The first line of the input contains the number  $t \leq 30$  of test cases. Each of the  $t$  test cases is described as follows.

- The first line contains three integers  $n \ m \ d$ , separated by a space. They denote

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<sup>1</sup>witches and wizards whose parents do not possess magical power

- $n$ , the number of Dementors ( $1 \leq n \leq 4 \cdot 10^4$ );
  - $m$ , the number of fugitives ( $1 \leq m \leq 9 \cdot 10^4$ ); and
  - $d$ , the largest distance of a Dementor from its last observed position during daytime ( $1 \leq d < 2^{50}$ ).
- The following  $n$  lines define the last observed positions of the Dementors. Each position is described by two integer coordinates  $x \ y$ , separated by a space and such that  $|x|, |y| < 2^{50}$ . You may assume that these positions are pairwise distinct.
  - The next  $m$  lines describe the relevant information about the fugitives. The  $i$ -th line contains three integers  $x \ y \ s$ , separated by a space and such that  $1 \leq s$  and  $|x|, |y|, s < 2^{50}$ . Here  $x$  and  $y$  define the initial position of person  $p_i$ , and  $s$  defines the safe distance  $s_i$  that person  $p_i$  requires when their Patronus is around, as explained above.

**Output** For each test case, output one line with a single character “y” or “n” for each fugitive, that is, a string  $c_0 c_1 \dots c_{m-1}$  of  $m$  characters. For each  $i \in \{0, \dots, m-1\}$ , the character  $c_i$  is “y” if and only if there exists a safe spot to spend the night for person  $p_i$ , as explained above.

**Points** There are four groups of test sets, worth 100 points in total.

1. For the first group of test sets, worth 30 points, you may assume that the fugitives do not need to move. That is, either the initial position of each person is a safe spot for that person or there is no safe spot for them.
2. For the second group of test sets, worth 30 points, you may assume  $m \leq 100$  and that a person can move to a safe spot if and only if they can move arbitrarily far away from all potential Dementor locations.
3. For the third group of test sets, worth 20 points, you may assume that a person can move to a safe spot if and only if they can move arbitrarily far away from all potential Dementor locations.
4. For the fourth group of test sets, worth 20 points, there are no additional assumptions.

Corresponding sample test sets are contained in `testi.in/out`, for  $i \in \{1, 2, 3, 4\}$ .

**Sample Input**

```
1
12 5 1
-3 7
0 7
1 7
4 6
0 4
-3 3
3 3
-4 0
```

```
4 0
-3 -3
0 -4
3 -3
-2 -2 1
2 0 1
-2 5 1
2 5 1
1 0 2
```

**Sample Output**

```
nyynn
```