Topic 10: Offline: CDQ, Mo's Algorithm

Handout

CS 41100 - CP3 Competitive Programming III (Spring 2024)
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Sample Problem: Ispiti
Link: `https://vjudge.net/Kattis-ispiti`

Sample Problem: Cupid
Link: `https://vjudge.net/Kattis-cupid`

Ispiti

It's exam time in Mirko's village. Everyone wants to pass the exam with as little effort as possible, which is not easy. Mirko realized that it would be best for him to find someone who knows more than him and learn from them. Everyone followed and now everyone is looking for someone to learn from. We can model how well a student is prepared for the exam with two integers, A and B. The number A represents how well a student understands the subject, while the number B is proportional to the quantity of their knowledge.

As the head of the village, Mirko decided that a student will ask another student for help only if that student has both numbers greater than or equal to the first student's numbers (no student will ask someone who doesn't understand the subject as well as themselves or who knows less). Additionally, students will try to minimize the difference in knowledge quantity (so that students don't bother those that are way better). If this choice is not unique, they will try to minimize the difference in understanding.

Mirko's village has recently become a very popular suburb and new students keep moving in (in time for the exam). With Mirko's strict rules, they get confused about Mirko's rules and don't know where to go. They decided to ask a programmer from a neighboring village for help.

Input

The first line of input contains an integer N ($1 \leq N \leq 200,000$), the number of queries and arrivals in the village. Each of the following N lines contains either: - "D A B", a student has moved in whose knowledge is A and B. - "P i", the i-th student to move in wants to know whom to ask for help.

The numbers A and B are between 1 and $2 \cdot 10^9$. No two students have both numbers equal.

Output

For each query ("P i" line), output which student the i-th student should ask for help. The students are numbered in the order they moved into the village (starting from 1). If a student cannot be helped, output "NE".

Examples

Input

```
6
D 3 1
D 2 2
D 1 3
P 1
P 2
P 3
```

Output

```
NE
NE
NE
```

Input

```
6
D 8 8
D 2 4
D 5 6
P 2
```

```
D 6 2
P 4
```

Output

```
3
1
```

Input

```
7
D 5 2
D 5 3
P 1
D 7 1
D 8 7
P 3
P 2
```

Output

```
2
4
4
```

Cupid

There are K different languages in the world. Each person speaks one and only one language. There are exactly N single men and N single women.

Cupid, the god of love, wants to match every single man to a single woman, and vice versa. Everybody wants to find a partner who speaks the same language as they do. Communication between the couple is very important! Cupid asks these N men to stand in a line, and likewise for the N women. Cupid knows that the ith man speaks language a_i and the ith woman speaks language b_i.

It is too hard for Cupid to match all people at the same time. What Cupid does is to repeatedly look at some specific interval in these two lines, pick the men and women in that interval and find the maximum number of man-woman pairs who speak the same language and can be matched.

Input

- The first line contains three integers N, M and K ($1 \le N \le 50,000, 1 \le M \le 50,000, 1 \le K \le 1,000,000$).
- The second line contains N integers $a_0, a_1, a_2, \ldots, a_{N-1}$, where a_i ($0 \le a_i < K$) is the language spoken by the ith man.
- The third line contains N integers $b_0, b_1, b_2, \ldots, b_{N-1}$, where b_i ($0 \le b_i < K$) is the language spoken by the ith woman.
- In the next M lines, each line contains two integers L and R ($0 \le L \le R < N$), representing the starting and ending index of the interval. That is, Cupid is looking at men $L, L+1, \ldots, R$ and women $L, L+1, \ldots, R$.

Output

For each interval, print the maximum number of couples Cupid could match.

Examples

Input

```
3 4 2
0 0 1
0 0 0
0 0
2 2
0 1
1 2
```

Output

```
1
0
2
1
```