Problem A: Bridges and Tunnels

It may feel warm now, but in a few months, Waterloo will be full of snow. Luckily, many of the buildings on campus are connected by bridges and tunnels, so you do not need to go outside very much. The network of buildings can be confusing, and it is hard to know the best way to get from one building to another. A computer program could help.

Input Specification

The first line of input contains three integers `0 < n <= 4000`, `0 < m <= 40000`, `0 < p <= 30`, the number of buildings on campus, the number of (indoor or outdoor) paths between the buildings, and the number of trips that you would like to make. Buildings are numbered sequentially from 0 to `n-1`. Each of the next `m` lines describes a path between buildings with three integers and a letter. The first two integers specify the two buildings connected by the path. The path can be taken in either direction. The third integer specifies the number of seconds required to take the path from one building to the other. The number of seconds is at least 0 and at most one million. Finally, the letter is `I` if the path is indoors, or `O` if the path is outdoors. Each of the next `p` lines describes a trip from one building to another using two integers, the numbers of the two buildings.

Sample Input

```
2 1 1
0 1 30 I
0 1
```

Output Specification

For each trip, find the optimal route between the specified two buildings. The optimal route minimizes the amount of time spent outside. Among routes that require spending the same amount of time outside, the optimal route minimizes the total time spent. For each trip, output a single line containing two integers, the time spent outside and the total time spent on the optimal route. If there is no route connecting the two specified buildings, output instead a line containing the word `IMPOSSIBLE`.

Output for Sample Input

```
0 30
```

Ondřej Lhoták, Ming-Yee Iu

Problem B: Secret Polynomial

You may have encountered IQ tests with inane questions such as the following: find the next number in the sequence 1, 2, 3, __. Obviously the correct answer is 16, since the sequence lists the values f(1), f(2), f(3), f(4), ..., where $f(x) = 2x^3 - 12x^2 + 23x - 12$. More generally, given some information about the values of a polynomial, can you find the polynomial? We will restrict our attention to polynomials whose coefficients are all non-negative integers.

Input Specification

The first line of input contains an integer `0 < n <= 10000`, the number of polynomials to be identified. Each of the next `n` lines contains two integers, the values f(1) and f(f(1)), where f is the polynomial to be found. Each of these values fits within the range of a signed two's complement 32-bit integer.

Sample Input

```
1
3 5
```

Output Specification

For each polynomial to be found, output a single line listing its coefficients separated by spaces. Assuming the degree of the polynomial is d, list the d+1 coefficients in descending order of power (i.e. starting with the coefficient of x^d and finishing with the coefficient of x^0). If the polynomial is the zero polynomial, just output 0. If no polynomial f has the desired values of f(1) and f(f(1)), instead output a line containing the word `IMPOSSIBLE`. If multiple polynomials f have the desired values of f(1) and f(f(1)), instead output a line containing the word `AMBIGUOUS`.

Output for Sample Input

```
1 2
```

Ian Goldberg, Ondřej Lhoták

Problem C: Room Painting

Joe's landlord has allowed him to paint his room any colour that he wants, even multiple colours. Joe has come up with a very colourful design. Now he needs to buy the paint. Being a struggling student, Joe does not want to waste any money, so he has calculated the exact amount that he needs of each colour down to the microlitre. To his surprise, however, the local paint shop is unwilling to sell him a can of exactly 3.141592 litres of red paint. No, the shop has a set of specific paint can sizes. Joe has no choice but to buy a little bit more paint than he really needs. Still, he would like to minimize the amount of paint wasted. In addition, he does not want to buy more than one can of any given colour.

Input Specification

The first line of input contains two integers `0 < n <= 100000` and `0 < m <= 100000`, the number of paint can sizes offered by the paint shop, and the number of colours that Joe needs. Each of the next `n` lines contains the size of a can offered by the paint shop, in microlitres. Each can contains no more than 1000 litres. Each of the next `m` lines contains the number of microlitres that Joe needs of a given colour. It is guaranteed that for each colour, the paint shop sells a can large enough to satisfy Joe's needs.

Sample Input

```
3 2
5
7
9
6
8
```

Output Specification

Output a single line, the total number of microlitres of paint wasted if Joe buys, for each colour, the smallest can that satisfies his needs.

Output for Sample Input

```
2
```

Ondřej Lhoták

Problem D: Course Scheduling

It is a difficult job to schedule all of the courses in a university to satisfy students' choices with a minimum of conflicts. The task is made all the more difficult when some students don't pre-enroll, or pre-enroll multiple times because they forget that they already did it.

Input Specification

The first line of input contains an integer `0 < n <= 100000`, the number of student course requests. Each of the next `n` lines contains three strings separated by spaces: a student's first and last name, and the course that the student wishes to take. You may assume that each name is a string of at least one and at most 20 upper-case letters, and that a course is a string of at least one and at most 10 upper-case letters and digits. If a student requests a given course more than once, only the first such request should be considered. You may assume that no two students have both their first and last names the same.

Sample Input

```
1
PINK TIE CS241
```

Output Specification

For each requested course, output a line containing the course, a space, and the number of students who requested the course. Output the courses sorted in lexicographical order (with digits sorted before letters).

Output for Sample Input

```
CS241 1
```

Ondřej Lhoták

Problem E: Tetrahedron Inequality

It is well known that you cannot make a triangle with non-zero area whose sides have lengths 1, 2, 3. Can you make a tetrahedron with non-zero volume whose edges have lengths 1, 2, 3, 4, 5, 6?

Input Specification

The first line of input contains an integer `0 < n <= 10000`, the number of lines to follow. Each of the next `n` lines contains six positive integers separated by spaces, the lengths of the edges of the desired tetrahedron. The length of each edge is no greater than one million.

Sample Input

```
1
1 2 3 4 5 6
```

Output Specification

Output `n` lines, each containing the word `YES` if it is possible to construct a tetrahedron with non-zero volume with the given edge lengths, or the word `NO` if it is not possible.

Output for Sample Input

```
NO
```

Ondřej Lhoták