Problem A
A Chair Problem

Time limit: 1 second
Memory limit: 256 megabytes

Problem Description

It's September and your little brother starts elementary school. For better ergonomics, the teacher has to know who are taller or shorter to select their tables and chairs. One noticeable thing is some pupils have difficulty telling who's taller if they're of the same height standing on different chairs. To help the pupils understand, the teacher makes them compare their heights several times and notes the results on a sheet. There are n pupils, whose heights are H_1, H_2, ..., and H_n, conducting m comparisons in the class. There are many chairs, each of which has height either C_1, C_2, ..., or C_k, while $C_0 = 0$ denotes the ground. Since some pupils may report the results incorrectly, the teacher needs you to check if there is any error on the sheet.

Input Format

The first line contains two integers n and m. Each of the next m lines contains four integers i, u, j, v indicating that $H_i + C_u \leq H_j + C_v$.

Output Format

Please output `YES` if there exists a set of positive real numbers H_1, H_2, ..., H_n and C_1, C_2, ..., C_k such that all inequations are satisfied. Otherwise, output `NO`.

Technical Specification

- $2 \leq n \leq 10^3$
- $1 \leq m \leq 10^5$
- $k = 1$
- $1 \leq i \leq n$, $1 \leq j \leq n$, $i \neq j$
- $0 \leq u \leq k$, $0 \leq v \leq k$

Sample Input 1

```
2 1
1 0 2 1
```

Sample Output 1

```
YES
```

Sample Input 2

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

Sample Output 2

```
NO
```

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Problem B
Both Chairs

Time limit: 1 second
Memory limit: 256 megabytes

Problem Description

It's September and your little brother starts elementary school. For better ergonomics, the teacher has to know who are taller or shorter to select their tables and chairs. One noticeable thing is some pupils have difficulty telling who's taller if they're of the same height standing on different chairs. To help the pupils understand, the teacher makes them compare their heights several times and notes the results on a sheet. There are n pupils, whose heights are H_1, H_2, ..., and H_n, conducting m comparisons in the class. There are many chairs, each of which has height either C_1, C_2, ..., or C_k, while $C_0 = 0$ denotes the ground. Since some pupils may report the results incorrectly, the teacher needs you to check if there is any error on the sheet.

Input Format

The first line contains two integers n and m. Each of the next m lines contains four integers i, u, j, v indicating that $H_i + C_u \leq H_j + C_v$.

Output Format

Please output `YES` if there exists a set of positive real numbers H_1, H_2, ..., H_n and C_1, C_2, ..., C_k such that all inequations are satisfied. Otherwise, output `NO`.

Technical Specification

- $2 \leq n \leq 500$
- $1 \leq m \leq 10^4$
- $k = 2$
- $1 \leq i \leq n$, $1 \leq j \leq n$, $i \neq j$
- $0 \leq u \leq k$, $0 \leq v \leq k$

Sample Input 1

```
2 1
1 0 2 1
```

Sample Output 1

```
YES
```

Sample Input 2

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

Sample Output 2

```
NO
```

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Problem C
Chairs

Time limit: 1 second
Memory limit: 256 megabytes

Problem Description

It's September and your little brother starts elementary school. For better ergonomics, the teacher has to know who are taller or shorter to select their tables and chairs. One noticeable thing is some pupils have difficulty telling who's taller if they're of the same height standing on different chairs. To help the pupils understand, the teacher makes them compare their heights several times and notes the results on a sheet. There are n pupils, whose heights are H_1, H_2, ..., and H_n, conducting m comparisons in the class. There are many chairs, each of which has height either C_1, C_2, ..., or C_k, while $C_0 = 0$ denotes the ground. Since some pupils may report the results incorrectly, the teacher needs you to check if there is any error on the sheet.

Input Format

The first line contains two integers n and m. Each of the next m lines contains four integers i, u, j, v indicating that $H_i + C_u \leq H_j + C_v$.

Output Format

Please output `YES` if there exists a set of positive real numbers H_1, H_2, ..., H_n and C_1, C_2, ..., C_k such that all inequations are satisfied. Otherwise, output `NO`.

Technical Specification

- $2 \leq n \leq 44$
- $1 \leq m \leq 4444$
- $k = 4$
- $1 \leq i \leq n$, $1 \leq j \leq n$, $i \neq j$
- $0 \leq u \leq k$, $0 \leq v \leq k$

Sample Input 1

```
2 1
1 0 2 1
```

Sample Output 1

```
YES
```

Sample Input 2

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

Sample Output 2

```
NO
```

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Problem D
Temperature Difference

Time limit: 10 seconds
Memory limit: 256 megabytes

Problem Description

Gaia travels among planets via (bidirectional) wormholes. She starts from planet X and plans to reach planet Y. There may or may not exist a wormhole that connects planets X and Y directly. Therefore, on some occasions, it is necessary to traverse along a sequence of wormholes rather than just a single one. Some intermediate planets other than X and Y are visited while transferring from one wormhole to another. Given the temperature of all planets, Gaia would like to search for a sequence of wormholes from planet X to Y that minimizes the temperature difference between the hottest visited planets and the coldest visited one. For the sake of simplicity, we assume that planet X has temperature X (K) for each X.

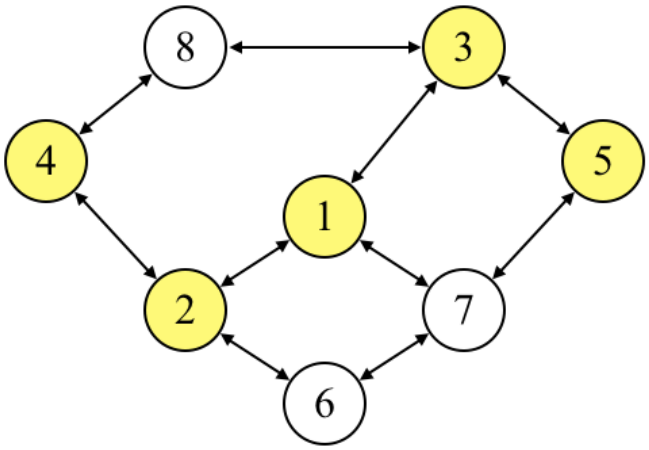

Figure 1: If $X = 4$ and $Y = 5$, then the best route for Gaia to reach Y from X is $4 \to 2 \to 1 \to 3 \to 5$ because it has the smallest temperature difference 4.

Input Format

In the first line, three integers n, m, k are given. n is an integer in $[1, 3000]$ that denotes the number of planets, and m is an integer in $[1, n(n-1)/2]$ that denotes the number of wormholes. k is an integer in $[1, 20]$ that specifies the number of queries. The n planets are numbered from 1 to n. Then the description of the m wormholes follows. Each wormhole is specified by the identifier of the end-planets, u and v for some $u \neq v \in \{1, 2, \ldots, n\}$. Then the description of the k queries follows. Each query gives an (X, Y) pair. You may assume that the planets are connected.

Output Format

For each query, output the smallest temperature difference on a unique line.

Sample Input 1

```
8 10 3
4 8 8 3 3 5
4 2 2 1 1 7 7 5
2 6 6 7
1 3
4 5
1 6
8 8
```

Sample Output 1

```
4
5
0
```

Problem E
Exhausted `mangojunior`

Time limit: 2 seconds
Memory limit: 256 megabytes

Problem Description

One of `mangojunior`'s jobs is to deal with the management affairs of a mysterious classroom. The classroom is a $r \times c$ grid, so there are totally $r \times c$ blocks. There are n craft chairs numbered from 1 to n in the classroom. They are designed to be stacked on a certain magic block which lies on the intersection of row i and column j. Moreoever, chair k can be put over the top of some chair numbered with an integer less than k, and chairs are not allowed to be stacked on all the other blocks.

`mangojunior` plans to clean up the classroom. He observed that there is no chair on the magic block, so he can clean it first. Then, he can stack all the chairs on the magic block and clean the other blocks. In every step, `mangojunior` can select chair k and move it to an adjacent block which must be a block without chair or the magic block with a stack of chairs of number less than k. During the final exam period, `mangojunior` is exhausted. Once a chair moved into the magic block, `mangojunior` does not have enough energy to move it to another block. Please help `mangojunior` determine how many steps does he need to move all chairs to the magic block?

Input Format

The first line contains an integer T indicating the number of test cases. The first line of each test case contains three integers r, c, and n describing the size of the classroom and number of chairs. The second line of each test case contains two integers i and j denote the position of the magic block. The following n lines describe the positions of the chairs. The k-th line of them contains two integers i_k and j_k denote the position of chair k. No two given positions are the same and there is no chair on the magic block initially.

Output Format

For each test case, output one line containing the minimum number of moves which `mangojunior` needs to perform. The answer is guaranteed to be less than 13.

Technical Specification

- $1 \leq T \leq 10$
- $1 \leq r, c$ and $r \times c \leq 30$
- $0 \leq i < r$ and $0 \leq j < c$
- $0 \leq i_k < r$ and $0 \leq j_k < c$ for $k \in \{1, 2, ..., n\}$
- $1 \leq n \leq 8$

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Problem F
Fortune

Time limit: 1 second
Memory limit: 256 megabytes

Problem Description

The mayor of Takao City wants to make money! He decides to invest in some stocks. By the power of the city mayor, he can know the best stock of each day. In day i, he can earn b_i dollars by investing one unit of stock. He can invest up to k_i units of stock in that day. However, he is not allowed to invest a fractional unit. He must invest an integral number of units.

The mayor can simply invest k_i unit in day i earning the maximum amount of money. But he wants to create a illusion of making more and more money. He decided to make the amount of the money earned increase everytime he invests. To keep the amount of earnings increasing, he may need to not invest somedays. What is the maximum days he can achieve?

Input Format

First line contains the number of testcases T. For each testcase, the first line contains the number of days n. The second line contains n numbers from b_1 to b_n. The third line contains n numbers k_1 to k_n.

Output Format

For each testcase, output a number indicating the maximum day keeping the illusion.

Technical Specification

- $1 \leq T \leq 10^2$
- $1 \leq n \leq 10^3$
- $1 \leq b_i \leq 10^9$ and $1 \leq k_i \leq 10^2$ for $i \in \{1, \ldots, n\}$.

Sample Input 1

```
10
1
2
5
10
22
55
100
222
555
1000
```

Sample Output 1

```
0
1
4
6
9
11
13
15
18
20
```

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Problem G
Greatness of Subarrays

Time limit: 4 seconds
Memory limit: 256 megabytes

Problem Description

$s_0, \ldots, s_{n-1}$ is a sequence of integers. In this problem, a subarray of a sequence is an array containing some consecutive elements of the sequence. `harryooooooooooo` defines the greatness of a continuous segment $s_\ell, s_{\ell+1}, \ldots, s_{r-1}$ as its longest subarray which forms an arithmetic sequence. In other words, the greateness of $s_\ell, s_{\ell+1}, \ldots, s_{r-1}$ is the length of its longest subarray which owns the following feature: there exist two integers a and d such that the subarray can be described as $a, a+d, a+2d, \ldots, a+(m-1)d$, where m denotes the length of subarray. To make this problem harder, `harryooooooooooo` sometimes modifies the sequence. He chooses a subarray and increases or decreases all elements with an integer v. Please find the answers for him.

Input Format

The first line contains an integer n which is the length of the sequence. The second line contains n integers denoting the elements of the sequence $s_0, \ldots, s_{n-1}$. The third line contains an integer q, the number of operations. Then the following q lines are operations in one of following forms:

- 1 ℓ r v: increase the elements in range $[\ell, r)$(including ℓ and excluding r) by v. A negative v means decreasing by $-v$.
- 2 ℓ r: query the greatness of $s_\ell, \ldots, s_{r-1}$.

Output Format

For every type-2 operations, output an integer in one line.

Technical Specification

- $1 \le n \le 10^5$
- $1 \le q \le 10^6$
- $-10^9 \le s_i \le 10^9$ for $i \in \{0, \ldots, n-1\}$
- $0 \le \ell < r \le n$
- $-10^3 \le v \le 10^3$

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Problem H
Hank's Challenge

Time limit: 1 second
Memory limit: 256 megabytes

Problem Description

Hank likes colorful triangles. He collects many sticks in various colors and wants to use them to build as many triangles as possible under the following constraints.

1. Each triangle must consist of exactly three sticks of distinct colors.
2. Every pair of triangles must consist of sticks of at least five distinct colors.

For example, if Hank builds a triangle with the color red, blue, and green, he cannot to build another triangle with color red, blue, and purple. This violate the second constraint.

You just discovered that Hank's collection of sticks has exactly 3^n different color in total. And there are at least 2^{100} sticks of each color. Hank is too tired during the final exam period, so he asks you to help him to build the triangle.

Input Format

The input has only one line with a number n. Hank's collection has exactly 3^n colors.

Output Format

The first line contain a number m – the number of triangle you can build. If m is no greater than 10^5, then you have to output m more lines to show how to build the triangles. Each of the m lines will contain three number indicate the colors of sticks building the corresponding triangle. Use only the integers between 1 to 3^n to indicate the different color. If there are multiple answer, you can print any of them.

Technical Specification

n is no more than 20.