108 學年度
全國大專電腦軟體設計競賽
台大校內初賽

National Taiwan University

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Language	Version	Compile Flags	Extensions
C	gcc 9.1.0	`-O2 -std=c11 -static -lm`	`.c`
C++	g++ 9.1.0	`-O2 -std=c++17 -static -lm`	`.cc, .cpp`

Problem	Problem Name	Time Limit	Memory Limit
A	Cut the Sequence	3 s	1024 MB
B	The Answer to the Ultimate Question of Life, The Universe, and Everything	1 s	1024 MB
C	Military modernization	5 s	1024 MB
D	Decode the Ultimate Question of Life, The Universe, and Everything	1 s	1024 MB
E	Joe's Fence	10 s	1024 MB
F	Criminal	10 s	1 MB
G	How many different breeds of cats	5 s	1024 MB
H	Super Joe	5 s	1024 MB
I	It is an easy problem	1 s	64 MB
J	Cats line up	1 s	1024 MB

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A. Cut the Sequence

The score of a sequence of integers is defined as the bitwise-or value of all numbers in the sequence.

Now you are given a sequence of integers $a_0, a_1, \cdots, a_{N-1}$, and you must cut the sequence into K consecutive segments. Find the maximum possible value of the sum of scores of all K segments.

Input

The first line contains two positive integers N and K ($K \leq N \leq 2 \times 10^5$) — the length of the sequence and the number of segments.

The second line contains N non-negative integers $a_0, a_1, \cdots, a_{N-1}$ ($a_i < 2^{32}$).

Output

Output the maximum possible value of the sum of scores of all K segments.

Sample Input 1	Sample Output 1
8 3 2 9 14 3 6 8 11 6	45

Sample Input 2	Sample Output 2
6 2 1 2 3 4 5 6	14

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B. The Answer to the Ultimate Question of Life, The Universe, and Everything

For decades, scientists have wondered whether each of the numbers from 0 to 100 could be represented as the sum of three cubes, where a cube is the same number multiplied together three times. 42 was the last number without a proven solution — until now.

The solution is $(-80538738812075974)^3 + 80435758145817515^3 + 12602123297335631^3 = 42$

Now, Eddy is suspicious of the existence of other solutions. But, the solutions are not so trivial to find out. Eddy wants to find out easy solutions first. That is, for the equation $a^3 + b^3 + c^3 = x$, Eddy wants to find out at least one solution for each integer x in $[0, 200]$, where $|a|, |b|, |c| \leq 5000$.

Since Eddy is still busy preparing the test data of some (this?) problem, please help him find out at least one solution for each x or tell him that the solution doesn't exist when $|a|, |b|, |c| \leq 5000$.

Input

The first line contains an integer T indicating the number of x to be checked. Following T lines each contains one integer x.

- $1 \leq T \leq 10$
- $0 \leq x \leq 200$

Output

For each test case, output one line containing three space-separated integers a, b, c such that $a^3 + b^3 + c^3 = x$ and $|a|, |b|, |c| \leq 5000$. If the solution doesn't exist, output `"impossible"` (without quotes).

Sample Input 1	Sample Output 1
2 1 2	1 1 -1 1 1 0

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C. Military modernization

The country, *Meow*, is a prosperous country. Its national defense power is so strong that terrifies all its neighboring countries. However, with the development of the military technology, *Meow* began to modernize its military.

The modernization costs lots of funds and manpower, and the process takes as long as T months. Therefore, during the process, the national defense power of *Meow* would be unstable. As the supreme leader of *Bark*, an enemy country of *Meow*, you'd like to take the chance to invade *Meow*.

Concretely speaking, there are N military bases in *Meow*, numbered from 0 to $N-1$. You will not stop the invasion until you occupy all N military bases. There are M bidirectional roads connecting the bases. The i-th road connect base u_i and base v_i. The N bases are connected. That is to say, it is possible to go from any base to any other one using only roads.

The situation of the war may be affected by the progress of the modernization. In the following description, t **represents the number of months that the modernization has lasted for**.

You planned to go to war with a *blitzkrieg* strategy:

1. Occupy base 0 at the beginning.
2. Choose a road connecting an occupied base A and an unoccupied base B, and occupy B by the road.
3. Repeat step 2 until all the bases are occupied.

According to intelligence agency, step 2 consumes $(w_i + t \times wp_i)$ units of army if road i is chosen.

In addition, *Meow* can destroy any number of roads, and the *Bark* armies cannot pass the destroyed roads anymore. However, because the *Meow* armies still need to support one another, a road can be destroyed only if all N bases (including those occupied by *Bark* armies) are still connected by the remaining roads.

Also, *Meow* has an emergency budget to strengthen the defense work on roads. Spending 1 *meowcoin* (currency unit of *Meow*) on road i can increase army cost by $x_i + t \times xp_i$ units when *Bark* armies pass through road i. The emergency budget is s *meowcoin* before the modernization, and increases by sp *meowcoin* each month, so the budget will be $s + t \times sp$ when encountering attack. During the war, there's no spare army for defense enhancement, so all the budget needs to be consumed at the beginning of the war (that is, the month that *Bark* starts its invasion).

The budget can be distributed arbitrarily on any number of different roads, but the cost on each road needs to be an integer.

Though you've made the military plan, you still need to estimate the amount of armies that the plan will consume. Therefore, please write a program that calculates the minimum army consumption, given that you need to choose a month $0 \leq t < T$ to invade *Meow*. You must assume that *Meow* will adopt optimal strategies, including roads destruction and defense enhancement strategies.

Input

The first line contains 5 non-negative integers N, M, T, s, sp ($1 \leq N \leq 5 \times 10^4; 1 \leq M \leq 10^5; 1 \leq T \leq 10^6;$ $s \leq 10^8; sp \leq 100$). Their meanings are explained above.

In the following M lines, each line contains 6 integers $u_i, v_i, w_i, wp_i, x_i, xp_i$ ($0 \leq u_i, v_i < N; u_i \neq v_i;$ $0 \leq w_i \leq 10^{12}; |wp_i| \leq 10^6; w_i + T \times wp_i \geq 0; 0 \leq x_i \leq 10^8; 0 \leq xp_i \leq 100$). Their meanings are also explained above.

Output

Output one integer, which is the minimum number of units of army you need to consume.

Sample Input 1	Sample Output 1
4 5 5 0 1 0 1 10 0 1 0 0 3 15 -1 0 0 1 2 22 -2 1 0 1 3 13 -1 1 1 2 3 20 -2 1 0	49

D. Decode the Ultimate Question of Life, The Universe, and Everything

One day you picked up a hash function H on the way to National Taiwan University (don't ask me how), and you wanted to solve the reverse function of H (don't ask me why).

The hash function H is a function that maps ascii encoded string to 64-bit unsigned integer. Here's the C/C++ implementation of the function H (the input string `s` is null-terminated):

```c
#include <stdint.h>

uint64_t left_rotate(uint64_t val, int shift) {
  return (val << shift) | (val >> (64 - shift));
}

uint64_t H(const char *s) {
  uint64_t sum = 0;
  for (int i = 0; s[i] != '\0'; i++) {
    sum = left_rotate(sum, 4) ^ s[i];
  }
  return sum;
}
```

Now, given a value x, please find a string S such that $H(S) = x$. To make things more interesting, string S must only consist of capital English letters and its length should be exactly 21. (Note that 21 is the half of 42, which is the "Answer to the Ultimate Question of Life, the Universe, and Everything")

Input

The input contains multiple test cases.

The first line of input contains an integer T, indicating the number of test cases follow.

For each test case, there's only one integer x in a single line.

- $1 \leq T \leq 514$
- $0 \leq x < 2^{64}$

Output

If such string S exists, then output an arbitrary string satisfying all the conditions above. Otherwise, output `"impossible"` (without quotes).

Sample Input 1	Sample Output 1
2 6148914691231973380 7135684237936561404	AAAAAAAAAAAAAAAAAAAA THEANSWERTOEVERYTHING

E. Joe's Fence

Farmer Joe is very rich and he owns a large garden in Xinyi District. There are some old fences that form an convex N-gon (that is, polygon with N edges) border for the garden.

Christmas is coming, he wants to decorate the garden with K Christmas trees. Joe strongly believes that finding some good positions to plant the trees will give him some good luck. As a devout Taoist, he decides to find the best positions as follows:

- All trees should be on the border of the garden.
- These K trees should divide the perimeter of the garden equally.
- The area of the new convex K-gon formed by the trees should be as small as possible.

Although Joe is richer than you, he is not as smart as you. Therefore, he gives you some money and asks you to help him find the smallest area of the convex K-gon.

Input

The first line contains two integers, N and K ($3 \leq N, K \leq 1000$) — the number of vertices of the origin and new convex polygon.

Each of the next N lines contains two integers x_i and y_i, ($-10^5 \leq x_i, y_i \leq 10^5$), meaning the coordinates of the vertices of the garden's border.

The vertices are given counterclockwise.

Output

Output the smallest area of the convex K-gon. Your answer is considered correct if its relative or absolute error does not exceed 10^{-8}.

Sample Input 1	Sample Output 1
5 4 0 0 1 0 2 1 2 2 0 2	1.9892766953

Sample Input 2	Sample Output 2
3 3 0 0 0 1 1 0	0.1226170434

Sample Input 3	Sample Output 3
6 4 -2 0 0 0 1 1 0 2 -3 3 -4 2	5.3548059137

F. Criminal

Woof, a criminal, just sneaked out of the country *Meow*!

According to investigation, we found that *Woof* moved from cities to cities for N hours before his escape from *Meow*, in order to cover his tracks. There are S cities in *Meow*, numbered from 0 to $S-1$. *Woof* would either move to another city or stay in the same city every hour. In addition, the police has analyzed *Woof*'s moving pattern. If *Woof* is in city i currently, then the probability of him moving to city j next hour is $p_{i,j}$. However, the police has no clue about the initial city he stayed before moving. Therefore, we assume that the probability of each city being the initial city is the same.

Woof is so proficient in stealth that the police cannot determine the path of *Woof*. However, *Woof* still needs to communicate, so he would emit electromagnetic signals continuously. The signals are too weak to reveal its source position, but by analyzing the signals using artificial intelligence models, the police can classify the signals into T different types, numbered from 0 to $T-1$. Due to the limitation of the model, the signals in each hour will be classified into one of the T types by the model. If *Woof* was at city i in an hour, then the probability of the signal of the hour being classified into type j is $t_{i,j}$.

Now the police has sorted out the type of the signal in each of the N hours. Please find out the most probable moving path of *Woof*.

Input

The first line contains four positive integers S, E, T, N, ($S \leq 250, E \leq 600, T \leq 80, N \leq 70000$), representing the number of cities in *Meow*, the number of non-zero $p_{i,j}$'s, the number of types of signals, and the number of hours *Woof* stayed before his escape (which equals to the length of the signals), respectively.

In the following E lines, there are three numbers in each line. The first two numbers u, v are integers ($u, v < S$), meaning $p_{u,v} \neq 0$; the third number is a real number $p_{u,v}$ with six decimal places.

In the following S lines, there are T real numbers $t_{i,0}, \cdots, t_{i,T-1}$ each with six decimal places in the i-th line, where $t_{i,j}$ representing the probability of the signal being classified into type j when *Woof* is in city i.

The next line contains N integers x_i, representing the types of captured signals in each of the

N hours before *Woof*'s escape.

For every $0 \leq i < S$, $\sum_{j=0}^{S-1} p_{i,j} = \sum_{j=0}^{T-1} t_{i,j} = 1$.

Output

Please output N numbers, representing the cities *Woof* stayed in the N hours respectively, in the most probable path given the signals. Each number should be outputted in a single line. It is guaranteed that there is at least one path which is possible to generate the given signals.

Your answer will be regarded as correct if the relative error between the probabilities of your path and the most probable path is no more than 10^{-6}.

Sample Input 1	Sample Output 1
4 9 3 7 0 1 0.333333 0 3 0.666667 1 0 0.500000 1 1 0.200000 1 2 0.300000 2 0 0.400000 2 3 0.600000 3 1 0.350000 3 3 0.650000 0.100000 0.300000 0.600000 0.400000 0.100000 0.500000 0.000000 1.000000 0.000000 0.250000 0.500000 0.250000 1 0 2 0 1 1 2	2 3 3 3 3 3 1

G. How many different breeds of cats

Today, you came to a cat village. There are N cats in this village. Each cat is very cute, and all the N cats are very cleverly lined up in a row.

As we all know, there are B breeds of cats in the world. Breed of each cat from left to right in this village is $a_1, a_2, ..., a_N$.

Because you are a coder and cat lover who is very interested in cat breeds, you may be curious about the following type of question: given K intervals, $[l_1, r_1], [l_2, r_2], ..., [l_K, r_K]$, how many different breeds of cats which appear a positive even number times in the union (that is, if a cat appears in multiple intervals, it should be counted only once) of the K intervals?

Now, give you M such questions, can you answer all correctly?

Input

The first line contains three positive integers N, B and M ($1 \leq N, B, M \leq 10^5$) — the number of cats in this village, the number of breeds of cats in the world and the number of questions you need to answer.

The second line contains N positive integers $a_1, a_2, \cdots, a_N$ ($1 \leq a_i \leq B$).

The following M lines contain questions, one per line. The first integer in the line is K ($1 \leq K \leq 10^5$), followed by $2 \times K$ integers $l_1, r_1, l_2, r_2, \cdots, l_K, r_K$ ($1 \leq l_i, r_i \leq N$) in the same line.

It is guaranteed that the sum of all K's is not greater than 10^5.

Output

Print M lines. The i-th line contains one integer — the number of breeds of cats which appear a positive even number times in the given intervals.

Sample Input 1	Sample Output 1
5 3 5 1 3 2 1 2 1 1 2 1 1 3 1 1 4 2 1 2 4 5 3 1 1 3 3 5 5	0 0 1 1 1

H. Super Joe

Super Joe is a famous online game these days. It is a highly competitive, fast-paced action-strategy game designed for those who crave a hard-fought victory. People enjoy in playing this game, so does the designer, Joe.

At the beginning of each match, all players will be teleported to some positions, then they can move among the map and place some hexbnbs in any position. The hexbnb was the emergent fusion of magic and technology used to create exquisite artifacts, but it is used to create a destructive bomb in every second now. Initially, there are no hexbnbs in the map.

The bombs generated by different players' hexbnbs have different powers R_i. If it explodes, everything except the hexbnbs at the same row or column with the Manhattan distance from the bombs less than or equal to R_i will also explode. If some players are killed in some reaction, they will resurge in the next second. It's not difficult to imagine there will be some chain reaction if some bomb explodes, so it's important to calculate the potential hex power on the map. For each chain reaction including K bombs, we can calculate the potential hex power with the special hex function $H(K) = K^2 + 8K + 7$.

To simplify the problem, we guarantee that there is only one type of action in a second. The details are described in the input section.

Input

The first line contains two integers n, m ($1 \leq n \leq 5000, 1 \leq m \leq 10^5$), which is the number of players and queries, respectively. The second line contains n integers R_i ($1 \leq R_i \leq 5$), the power of their hexbnbs. In this problem, all the R_i's are identical in the same test case.

For the next n lines, Each line contains two integers x_i, y_i ($0 \leq x_i, y_i \leq 10^5$), the original position of player i.

For the next m lines, there are three types of queries:

- 1 p x y — If there is already a hexbnb placed at (x, y), player p removes the hexbnb and the bomb. There will be nothing at (x, y) in the next second. Otherwise, he places a hexbnb at (x, y). ($1 \leq x, y \leq 10^5, 0 \leq p < n$)
- 2 p x y — Player p moves to (x, y). The position of each player will be different at any time. ($1 \leq x, y \leq 10^5, 0 \leq p < n$)

- 3 p — Player p places a bomb and fires it at his location. The power of the bomb is also R_i. Output the number of players can be killed by player p in this second (Note that he will also kill himself). $(0 \leq p < n)$

Output

For each query 1, output the number of bomb chains and the total potential hex power on the map in this second. For each query 3, output an integer in a single line.

Sample Input 1	Sample Output 1
3 24 4 4 4 2 5 0 4 4 2 1 1 0 2 1 1 2 0 3 0 3 1 1 1 2 2 3 0 3 1 3 2 1 3 2 2 3 0 3 1 3 2 1 2 2 2 3 0 3 1 3 2 1 1 0 2 3 0 3 1 3 2 2 0 2 7 3 0 3 1 3 2	1 16 2 32 1 2 1 40 3 3 3 2 32 1 2 2 1 40 3 3 3 1 27 2 1 2 1 1 1

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I. It is an easy problem

A sequence of length N is called a permutation if the integers $1, 2, \ldots, N$ all appear exactly once.

Given a sequence $A_1, A_2, \ldots, A_N$, if a pair of integers (i, j) satisfies that $1 \leq i < j \leq N$ and $A_i > A_j$, then we call this pair as an inversion of this sequence. Besides, the inversion value of a sequence is defined as the number of inversions on this sequence.

Now, given two integers N and K, please compute the number of distinct permutations of size N with inversion value K.

Input

The input contains two integers in a single line, N and K.

- $2 \leq N \leq 514$
- $0 \leq K \leq \frac{N \times (N-1)}{2}$

Output

Output the number of distinct permutations of size N with inversion value K. As the answer could be too large, please output the result modulo 2013265921.

Sample Input 1	Sample Output 1
3 1	2

Sample Input 2	Sample Output 2
4 3	6

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J. Cats line up

Today, you came to a cat village. There are N cats in this village. Each **cat is very cute**, and all the N cats are very cleverly lined up in a row.

The cats in this village are very special!!! Why do I say that? Because the heights of these cats are unique, and they are all integer numbers between 1 and N.

As we all know, everyone dislikes standing next to someone who is too tall when taking pictures, because standing next to such a person would make you look short. Humans are like this, and so are cats.

Every cat wants the difference in the height of the cat standing next to it to be no more than K. A cat would be happy if the difference in the height between it and each of its neighbor(s) is no more than K.

Now, given the number of cats in this village and the height difference K that the cat can accept, could you calculate that how many ways can the cats line up to make all of them happy?

Input

The first line contains an integer T indicating the number of N, K you need to calculate. The following T lines each contains two integers N, K.

- $1 \leq T \leq 10^5$
- $1 \leq N \leq 10^6$
- $1 \leq K \leq 3$

Output

For each test case, output one line containing one integer x — the number of ways the cats can line up to make all of them happy modulo 998244353.

Sample Input 1	Sample Output 1
18 1 1 2 2 3 2 1 3 2 3 3 3 4 3 5 3 6 3 7 3 8 3 9 3 10 3 11 3 12 3 13 3 14 3 15 3	1 2 6 1 2 6 24 72 180 428 1042 2512 5912 13592 30872 69560 155568 345282