IMC Programming Contest 2025

Qualification Round

Contest Problems

A	Back to the Futures	
	Subtask 1	4 points
	Subtask 2	5 points
	Subtask 3	11 points
	Total	**20 points**

B	Numbers Puzzle	
	Subtask 1	4 points
	Subtask 2	6 points
	Subtask 3	10 points
	Total	**20 points**

C	Pair of Watchtowers	
	Subtask 1	4 points
	Subtask 2	8 points
	Subtask 3	13 points
	Total	**25 points**

D	Lettuce and Numbers	
	Subtask 1	4 points
	Subtask 2	7 points
	Subtask 3	24 points
	Total	**35 points**

This contest contains four problems.
For language documentation and judge server configuration, see https://sppcontests.org/contest.
Good luck.

Problem A
Back to the Futures
Time limit: 3 seconds

Sabine wants to trade some stocks and make as much money as possible. She has M dollars to start with and knows the future prices of S different stocks for the next D days (thanks to a time machine).

Sabine wants to keep her trading strategy simple. Each day, Sabine will choose **exactly one** of the following three options:

- Buy: Sabine chooses one type of stock, and buys any number of that stock she would like (at that day's price). She can only buy a whole number of stocks, so she may have some money left over. **Sabine can only choose this option if she currently has no stock.**
- Sell: Sabine sells all the stocks she has.
- Nothing: Sabine does nothing.

To avoid suspicion, she will choose the Buy option **at most T times**, where T is one or two. What is the maximum amount of money Sabine can end with?

Input

The first line of input contains four integers T ($1 \leq T \leq 2$), which is the maximum number of Buys Sabine can do, S ($1 \leq S \leq 10$), which is the number of different types of stocks, D ($2 \leq D \leq 200\,000$), which is the number of days, and M ($1 \leq M \leq 1\,000$), which is the amount of money Sabine starts with.

The next D lines describe each day's stock prices. Each line contains S integers each in the inclusive range from 1 to 1 000. The jth integer on the ith line is the price of stock j on day i.

Special constraints for subtasks:

Subtask 1:	$D \leq 20$ and $T = 1$	(Valid Sample Inputs: 1)	(4 points)
Subtask 2:	$D \leq 20$	(Valid Sample Inputs: 1 – 3)	(5 points)
Subtask 3:	No special constraints	(Valid Sample Inputs: 1 – 3)	(11 points)

Output

Display a single number, the maximum amount of money Sabine can have after D days.

Notes

In the first sample case, Sabine should:

Day 1: Buy four stocks of type 1, spending all twenty dollars, and

Day 2: Sell all four of her stocks, yielding forty dollars.

In the second sample case, Sabine is allowed to Buy up to twice, so the following sequence is valid:

Day 1: Buy five stocks of type 1,

Day 2: Sell all five of her stocks, yielding 125 dollars,

Day 3: Buy *six* stocks of type 1, keeping five dollars in cash,

Day 4: Sell all six of her stocks, yielding 150 dollars and bringing her total to \$155, and

Day 5: Nothing,

but in fact a better sequence can be achieved with only one Buy:

Day 1: Nothing,

Day 2: Buy six stocks of type 2, keeping ten dollars in cash,

Day 3: Sell all six of her stocks, yielding 150 dollars and bringing her total to \$160,

Day 4: Nothing, and

Day 5: Nothing.

Note that Sabine cannot both Buy and Sell on a single day, which prevents her from reinvesting the profit from type 2 to take advantage of type 1's price rise on the fourth day.

In the third sample case, Sabine should simply do nothing each day and keep her starting $20.

Sample Input 1

```
1 3 2 20
5 11 25
10 25 100
```

Sample Output 1

```
40
```

Sample Input 2

```
2 2 5 100
20 20
25 15
20 25
25 20
20 15
```

Sample Output 2

```
160
```

Sample Input 3

```
2 1 5 20
30
40
20
10
5
```

Sample Output 3

```
20
```

Problem B
Numbers Puzzle
Time limit: 3 seconds

You arrive late to class one day, expecting to be scolded. Instead, you find everyone staring at the whiteboard: $3 \times n$ numbers have been scribbled onto it. The lecturer turns to you.

"You are late. I will forgive you if you solve this puzzle. Group these numbers into n sets of three. Each set must either be three identical values (such as $[5, 5, 5]$, a student helpfully chimes in), or three consecutive values (such as $[6, 7, 8]$)."

You nod your head sagely. You cannot solve this problem, but perhaps your laptop can.

Input

The first line of input contains the integer n ($1 \leq n \leq 100\,000$).

The next line contains $3 \times n$ positive integers between 1 and 100 000 inclusive, describing the numbers on the whiteboard.

Special constraints for subtasks

Subtask 1:	$n = 1$	(Valid Sample Inputs: 1 – 3)	(4 points)
Subtask 2:	$n \leq 4$	(Valid Sample Inputs: 1 – 5)	(6 points)
Subtask 3:	No special constraints	(Valid Sample Inputs: 1 – 5)	(10 points)

Output

If it is impossible to group the numbers into n sets of three, display `Impossible`. Otherwise, display `Forgiven` followed by n lines, each representing a set.

The sets (and the numbers within a set) may be displayed in any order. If there are multiple solutions, any will be accepted.

Sample Input 1

```
1
4 6 5
```

Sample Output 1

```
Forgiven
4 6 5
```

Sample Input 2

```
1
8 8 8
```

Sample Output 2

```
Forgiven
8 8 8
```

Sample Input 3

```
1
7 4 5
```

Sample Output 3

```
Impossible
```

Sample Input 4

```
3
11 11 12 12 12 13 13 14 14
```

Sample Output 4

```
Impossible
```

Sample Input 5

```
4
1 2 10 3 7 8 2 8 2 9 9 2
```

Sample Output 5

```
Forgiven
9 7 8
2 3 1
2 2 2
8 10 9
```

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Problem C
Pair of Watchtowers
Time limit: 6 seconds

You've just been asked to plan the construction of two watchtowers in your local nature reserve. There is a straight trail which runs through the reserve from west to east.

Along the trail are n potential build sites. A team of surveyors has collected three critical pieces of information about each site: the exact location of the site on the trail, the number of trees that would need to be cut down to build the tower, and the "buffer radius" for the site.

The two sites you choose must be outside of each other's buffer radii. Keeping this constraint in mind, what is the fewest trees that need to be cut down?

Input

The first line of input contains the integer n ($2 \leq n \leq 200\,000$), which is the number of sites.

The next n lines describe the sites. Each of these lines contains three integers x ($0 \leq x \leq 10^9$), which is the distance the site is from the east end of the trail in metres, t ($0 \leq t \leq 10^8$), which is the number of trees that would need to be cut down, and r ($1 \leq r \leq 10^9$), which is the buffer radius. This means the other site you choose must be **strictly more** than r metres west or east of this site.

The sites are listed in increasing order of x. No two sites will have the same value of x.

Special constraints for subtasks

Subtask 1:	The radii of all towers are the same and $n \leq 1000$	(Valid Sample Inputs: 1 – 2)	(4 points)
Subtask 2:	The radii of all towers are the same	(Valid Sample Inputs: 1 – 2)	(8 points)
Subtask 3:	No special constraints	(Valid Sample Inputs: 1 – 3)	(13 points)

Output

If it is not possible to find two sites satisfying the condition, display `Delay`. Otherwise, display `Proceed`, followed by a single integer M, which is the fewest trees that need to be cut down.

Sample Input 1

```
4
400 6 200
800 5 200
1000 2 200
1200 3 200
```

Sample Output 1

```
Proceed
8
```

Sample Input 2

```
3
10 10 20
20 10 20
25 10 20
```

Sample Output 2

```
Delay
```

Sample Input 3

```
5
200 5 700
400 4 100
800 2 400
1100 1 1600
1300 6 100
```

Sample Output 3

```
Proceed
8
```

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Problem D
Lettuce and Numbers
Time limit: 10 seconds

Welcome to the newest IMC (International Media Corporation) game show, "Lettuce and Numbers". The game involves strings not of letters, but of lettuces! There are two types of lettuces: '`a`' and '`b`'.

The host explains that Lettuce and Numbers comprises two separate phases.

- **Phase 1.** You choose a string of length exactly N. However there are R banned prefix strings. The chosen string cannot begin with any of the banned prefixes.
- **Phase 2.** You perform a sequence of *merge* operations until just a single lettuce remains. A merge involves picking two adjacent lettuces and merging them into one. If the left lettuce is type x and the right lettuce is type y, then the resulting lettuce will be of type $L_{x,y}$ and you will earn $P_{x,y}$ points.

At the end, you get to eat the last lettuce while the host sums up the points earned across your merges. You want to find out the maximum number of points you can achieve. And to really impress everyone, you also want to find out how many different ways there are to achieve the maximum number of points.

Two ways are different if the constructed string is different or the sequence of merges is different.

Input

The first line of input contains two integers N ($1 \leq N \leq 300$) and R ($0 \leq R \leq 100$).

The next R lines list the banned prefixes. The length of each prefix is in the inclusive range from 1 to N. The sum of lengths over all banned prefixes does not exceed 300.

The next two lines each contain a two-character string, describing L. The characters on the first line are $L_{\mathtt{a},\mathtt{a}}$ and $L_{\mathtt{a},\mathtt{b}}$. The characters on the second line are $L_{\mathtt{b},\mathtt{a}}$ and $L_{\mathtt{b},\mathtt{b}}$

The next two lines each contain two integers, describing P. The integers on the first line are $P_{\mathtt{a},\mathtt{a}}$ and $P_{\mathtt{a},\mathtt{b}}$. The integers on the second line are $P_{\mathtt{b},\mathtt{a}}$ and $P_{\mathtt{b},\mathtt{b}}$. Each integer in P is in the inclusive range from 0 to 1000.

Special constraints for subtasks

Subtask 1:	$R = 0$ and $N \leq 6$	(Valid Sample Inputs: 1 – 3)	(4 points)
Subtask 2:	$R = 0$	(Valid Sample Inputs: 1 – 3)	(7 points)
Subtask 3:	No special constraints	(Valid Sample Inputs: 1 – 6)	(24 points)

Output

Display the highest possible number of points achievable and the number of ways to achieve it. Since the number of ways may be large, display it modulo 1 000 000 007. If there are no ways to complete the game, display `0 0`.

Sample Input 1

```
2 0
aa
ab
2 1
1 1
```

Sample Output 1

```
2 1
```

Sample Input 2

```
3 0
bb
ab
3 1
2 1
```

Sample Output 2

```
5 3
```

Sample Input 3

```
1 0
ab
bb
0 1000
1000 0
```

Sample Output 3

```
0 2
```

Sample Input 4

```
2 1
aa
ba
ab
3 2
1 1
```

Sample Output 4

```
2 1
```

Sample Input 5

```
2 2
a
b
ba
ab
1 2
3 4
```

Sample Output 5

```
0 0
```

Sample Input 6

```
3 3
a
ba
bba
aa
ab
5 5
5 1
```

Sample Output 6

```
2 2
```