CCC 2014 Stage 2
Day 1, Problem 1: Troyangles

Problem Description

Troy loves triangles. He especially likes counting triangles. He has an N-by-N grid consisting of either "." or "#" characters. Help him count the number of triangles formed only by "#" characters in the grid. Triangles are of the form

```
  #
 ###
#, ###, #####, etc.
```

More formally, a triangle of height h consists of h rows for some positive integer h. The ith row contains $2i - 1$ "#" characters for $i = 1, \ldots, h$. The rows are centred above each other so that they are symmetrical about a vertical line down their middle.

Input Specification

The first line contains the number N ($1 \leq N \leq 2000$) representing the size of the grid. The next N lines each contain N characters as described above.

You can assume that for test cases worth 20% of the marks, $N \leq 50$.

Output Specification

Output the number of triangles in the grid.

Sample Input

```
5
.....
.###.
.###.
#####
.....
```

Output for Sample Input

```
16
```

Explanation of Output for Sample Input

There are 11 triangles of height one, 4 triangles of height two and 1 triangle of height three.

CCC 2014 Stage 2
Day 1, Problem 2: King Gruff

Problem Description
King Gruff the Wolf rules over a happy, prosperous land inhabited by adorable Foxes. Unfortunately for them, he is not a nice king at all, and wants to make their lives miserable!

His country has N ($1 \leq N \leq 10^5$) cities, with M ($0 \leq M \leq 10^5$) roads running amongst them. The ith road allows one to travel from city X_i to a different city Y_i ($1 \leq X_i, Y_i \leq N$), in that direction only, and has a length of L_i ($1 \leq L_i \leq 10^4$) and a shutdown cost of C_i ($1 \leq C_i \leq 10^4$). There may be multiple roads running between a pair of cities, even in the same direction.

King Gruff particularly dislikes the Foxes living in two different cities A and B ($1 \leq A, B \leq N$), and would like to make it more inconvenient (or even impossible) to travel from city A to city B. In particular, he'll select a distance value D ($1 \leq D \leq 10^9$), and then simultaneously shut down every single road in his kingdom which is part of at least one path from city A to city B with total length no more than D. For each such road, however, he'll have to dig into his royal treasury and pay its shutdown cost. A path consists of a sequence of roads such that each road (except the first) starts at the city that the previous road ended at, and may visit a city or road multiple times.

Gruff is having trouble making up his mind about what value of D to choose, however - a larger value would make things more inconvenient for his Foxy subjects, but might cost him more money as well! As such, he'll consider Q ($1 \leq Q \leq 10^5$) different values, D_1, D_2, ..., D_Q. For each one, he'd like to know how many tax dollars would need to be spent to shut down all roads which lie on at least one sufficiently short path from city A to city B. Since you don't like Foxes either, you've agreed to help the Wolf write a program to calculate this!

Input Specification
The first line contains 4 integers, each separated by a space:

- N ($1 \leq N \leq 10^5$), the number of cities, followed by
- M ($0 \leq M \leq 10^5$), the number of roads, followed by
- A ($1 \leq A \leq N$), the starting city, followed by
- B ($1 \leq B \leq N$), the ending city.

Each of the next M lines contain four space-separated integers X_i, Y_i, L_i, and C_i, describing the road from X_i to Y_i with length L_i and shutdown cost C_i (where $1 \leq X_i, Y_i \leq N$, $1 \leq L_i, C_i \leq 10^4$).

The next line contains Q ($1 \leq Q \leq 10^5$), the number of different distance values to consider.

The next Q lines each contain one integer D_i ($1 \leq D_i \leq 10^9$), which is the distance value to consider in shutting down roads.

The following conditions hold for the input data:

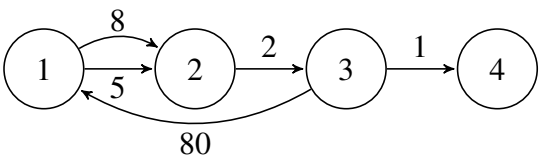
- For test cases worth up to 20% of the points, $N \leq 500$;
- For test cases worth up to 20% of the points, $Q = 1$;
- For test cases worth up to 80% of the points, $Q \leq 20$.

Output Specification
The output consists of Q lines, each with one integer, representing the total cost required to shut down all necessary roads given a distance value of D_i, for $i = 1..Q$

Sample Input 1
```
4 5 1 3
1 2 5 1
1 2 8 50
2 3 2 15
3 1 80 1000
3 4 1 1
4
8
6
90
94
```

Output for Sample Input 1
```
16
0
66
1066
```

Explanation of Output for Sample Input 1
The map of the country is illustrated below, with each road labelled with its length only:



If $D = 8$, the first and third roads need to be shut down, as they're both part of a path from city 1 to city 3 of length 7. This incurs a total cost of $1 + 15 = 16$.

If $D = 6$, no roads need to be shut down, as no paths from city 1 to city 3 with total length 6 or less exist.

If $D = 90$, the first three roads all need to be shut down.

If $D = 94$, the fourth road must additionally be shut down, as it lies on a path from city 1 to city 3 of length exactly 94, consisting of the first, third, fourth, first and then third roads.

Sample Input 2

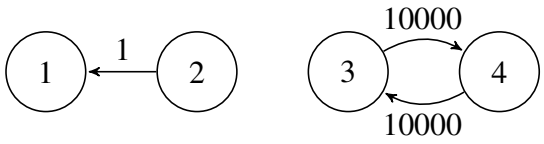
```
4 3 1 2
2 1 1 1
3 4 10000 10000
4 3 10000 10000
1
1000000000
```

Output for Sample Input 2

```
0
```

Explanation for Output of Sample Input 2

The map of the country is illustrated below:



As can be seen, the Foxes already have a problem, as no path from city 1 to city 2 exists! As such, for any value of D, King Gruff doesn't need to shut down any roads.

CCC 2014 Stage 2
Day 1, Problem 3: Werewolf

Problem Description
As they usually do, N robots are playing the game of Werewolf, and the robots are numbered with integers from 1 to N. Exactly W of these robots are werewolves, and the remainder are civilians. Though the game of Werewolf involves various aspects, we will focus on a single discussion phase of the game.

Robots accuse other robots of being werewolves and defend other robots by vouching for their innocence.

The werewolves know each other's identities and:

- a werewolf never accuses another werewolf;
- any robot that a werewolf defends is another werewolf.

Civilians may accuse or defend either type of robot.

Additional constraints make our task a bit easier:

- No robot is both accused and defended.
- No robot is accused or defended more than once.
- For a robot A to accuse or defend robot B, then $A < B$.

You will be given all the accusations and defenses between N robots where there are exactly W werewolves. A role assignment identifies each of the robots as either werewolf or civilian. Your goal is to figure out how many role assignments satisfy all the above constraints.

Input Specification
The first line contains three numbers (each separated by one space):

- N ($1 \leq N \leq 200$), the number of robots, followed by
- W ($0 \leq W \leq N$), the number of werewolves, followed by
- M ($0 \leq M < N$), the number of accusations/defenses.

The next M lines give the accusations and defenses. Each of these lines will be one of the following two forms:

- A a b indicates robot a accused robot b of being a werewolf;
- D a b indicates robot a defended robot b.

You may assume that for 20% of the marks for this problem, $N \leq 20$.

Output Specification
Output the number of role assignments that are consistent with the given information. Since this number may be very large, you must output this answer modulo $10^9 + 7$.

Sample Input 1
```
2 1 1
D 1 2
```

Output for Sample Input 1
```
1
```

Explanation of Output for Sample Input 1
If robot 1 is a werewolf, then robot 2 must also be, which is too many werewolves! The only possibility is that robot 2 is the sole werewolf.

Sample Input 2
```
2 1 0
```

Output for Sample Input 2
```
2
```

Explanation of Output for Sample Input 2
With no information, either robot 1 or robot 2 could be a werewolf.

Sample Input 3
```
3 2 2
A 1 2
D 1 3
```

Output for Sample Input 3
```
2
```

Explanation of Output for Sample Input 3
Either robot 1 is a werewolf, which implies robot 2 is a civilian and robot 3 is a werewolf as well, or robot 1 is a civilian (which allows robots 2 and 3 to both be werewolves).