Selection Questions for Odyssey

Instructions

1. There are 4 questions of increasing difficulty. The harder questions will take longer, but are worth more (marks are given alongside the question name).
2. The solution needs to run within 2 seconds for full marks. If the solution runs within 30 seconds, half points will be awarded.
3. Python, C and C++ are permitted.

Q1 We Went Car Racing (10)

Toto is in charge of selecting drivers to race for his team. There are a total of 20 drivers to pick from ($d_1, d_2 \dots d_{20}$), and 4 teams to which they can go to. Each team can pick one driver in their turn, after which the next team gets to pick and so on until all drivers are picked (and each team has 5 drivers). The organisers assign the numbers 1-4 to each of the teams before the drivers are to be picked.

Every driver has a score out of 100 in 4 properties – experience (e_i), racecraft (r_i), awareness (a_i) and pace (p_i) where i is the driver number. Each team also has a multiplier ($w_{e,j}, w_{r,j}, w_{a,j}, w_{p,j}$) where j is the team number for each of those properties. The score ($s_{i,j}$) of a driver i according to team j is calculated as follows:

$$s_{i,j} = \frac{w_{e,j}e_i + w_{r,j}r_i + w_{a,j}a_i + w_{p,j}p_i}{4}$$

Assume that on each turn, the other teams will pick the highest rated driver of all the remaining drivers. Here the team j compares drivers according to the scores given by $s_{i,j}$. Given the teams, their multipliers and which number has been assigned to Toto's team, find the best driver combination for Toto's team.

Input

The first line of input is an integer t ($1 \leq t \leq 4$) which is the number Toto's team has been assigned by the organisers.

The next 4 lines of input contain the 4 space separated floating point multipliers ($w_{e,j}\ w_{r,j}\ w_{a,j}\ w_{p,j}$).

The last 20 lines contain the 4 space separated integer ratings for each of the drivers ($e_i\ r_i\ a_i\ p_i$).

Output

A single line of output which contains the 5 space separated integers, the chosen drivers in order of selection.

Sample Input

```
2
1.2 0.8 1.0 1.0
1.0 1.3 1.0 0.7
1.0 1.0 1.0 1.1
1.0 1.5 1.0 0.5
94 94 85 98
72 96 82 99
78 90 93 91
83 88 81 88
65 91 89 90
72 92 96 87
93 93 88 88
65 92 80 81
82 94 93 85
63 92 86 93
99 91 86 89
63 95 86 79
62 92 88 91
53 81 78 78
99 90 81 86
58 84 80 82
54 67 89 85
54 65 78 65
63 75 86 84
59 73 79 70
```

Sample Output

```
11 3 5 8 14
```

Explanation

The best pick for team 1 will be driver 1 with a score of $(1.2 \times 94 + 0.8 \times 94 + 1.0 \times 85 + 1.0 \times 98)/4 = 92.75$.

The best pick for team 2 would have also been driver 1 (score of 92.45), but since he has already been taken, the best pick will be driver 11 with a score of $(1.0 \times 99 + 1.3 \times 91 + 1.0 \times 86 + 0.7 \times 89)/4 = 91.4$.

Similarly, team 3 picks driver 7 (score of 92.7), and then team 4 picks driver 9 (score of 89.625). After team 4, the turn cycles back to team 1 who picks driver 15 (score of 89.45).

The next best driver for team 2 will be driver 3 with a score of $(1.0 \times 78 + 1.3 \times 90 + 1.0 \times 93 + 0.7 \times 91)/4 = 87.925$, and so on until team 4 picks driver 18 at the end.

Q2 Jai Jawan, Jai Kisan (20)

Vishnu owns a very long field. He plans to grow different types of crops in the upcoming growing season. The area, however, is full of crows and Vishnu fears that they might feed on his crops. Thus, he has decided to place some scarecrows at different locations of the field.

The field can be modeled as a $1 \times N$ grid. Some parts of the field are infertile, and so he cannot grow any crops on them. A scarecrow when placed on a cell covers the cell to its immediate left and right along with the cell it is on.

Given the description of the field, what is the minimum number of scarecrows that need to be placed so that all crops are covered?

Input

The first line contains an integer $T \leq 100$, denoting the number of test cases.

Each case starts with a line containing an integer N ($0 < N < 100$). The next line contains N characters that describe the field. A dot (`.`) indicates a crop-growing spot and a hash (`#`) indicates an infertile region.

Output

For each case, output the number of scarecrows that need to be placed.

Sample Input

```
3
3
.#.
11
...##....##
2
##
```

Sample Output

```
1
3
0
```

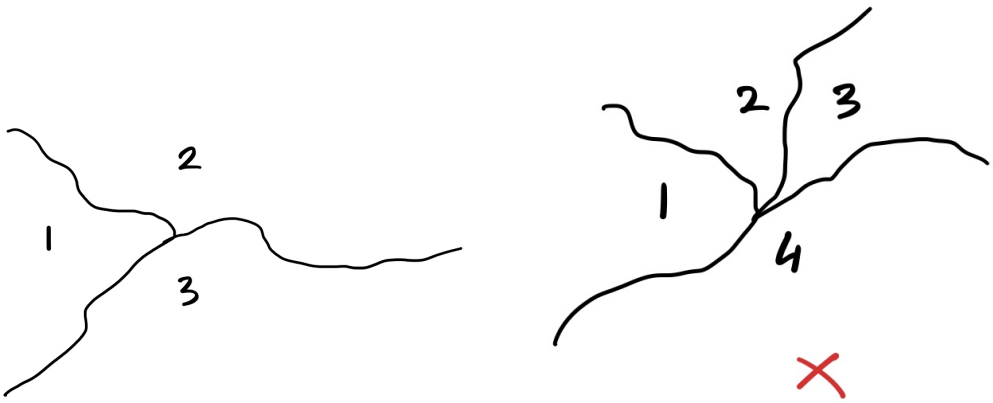
Explanation

The following scarecrow arrangements can be used (S denotes a scarecrow).

```
.S.
.S.#S..S.##
##
```

Q3 Map colouring (35)

Anirudh is a map maker and as part of his job, he is required to colour maps to make them more readable. It is known that no more than three states can meet at a point.



(a) Up to 3 states can meet at a point (b) 4 or more do not occur

Given Anirudh has K colours in his palette, how many ways can he colour a given map such that no two adjacent states are coloured the same?

Note that the same colour can be used any number of times.

Input

The first line contains three space separated integers (N M K) where N ($N \leq 10^5$) is the number of states, M ($M \leq 10^5$) is the number of borders between states and K ($K \leq 10^9$) is number of colours available.

The next M lines contains two space separated integers (u v; $1 \leq u, v \leq N$) which denotes a border between state u and state v.

Output

A single line containing the number of ways to colour the map, modulo $10^9 + 7$.

Sample Input

```
4 4 3
1 2
1 3
2 3
3 4
```

Sample Output

```
12
```

Explanation

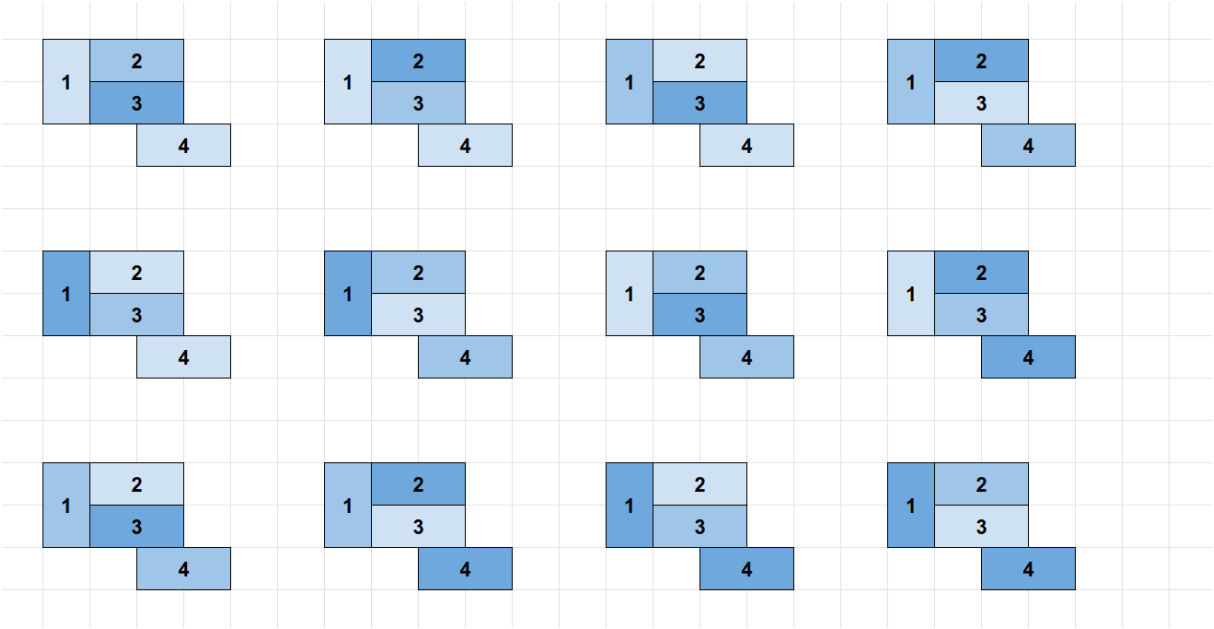
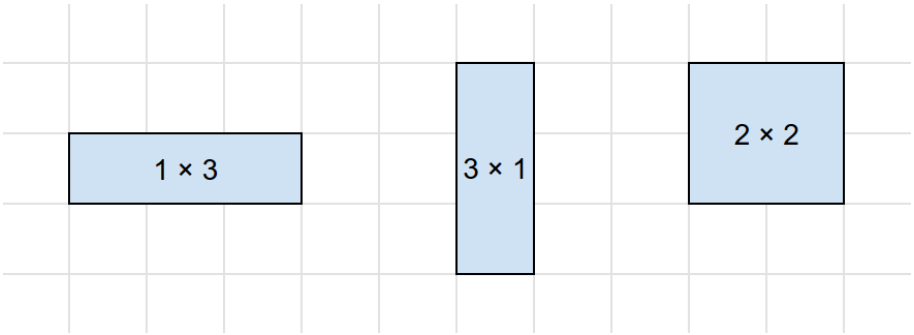


Figure 1: As can been seen above, there are 12 ways to colour the map.

Q4 Chocolate bar (35)

Ram is in charge of the welfare program for a chocolate company. The company can manufacture $3 \times N$ sized bars where $1 \leq N \leq 10^5$. As the head of welfare, it is his job to split the bars of chocolate such that every piece is either a 1×3, 3×1 or a 2×2. Find the number of ways he can do so.



Input

A single line containing the integer N.

Output

A single line containing the number of ways you can split a chocolate, modulo $10^9 + 7$.

Sample Input

```
6
```

Sample Ouput

```
8
```

Explanation

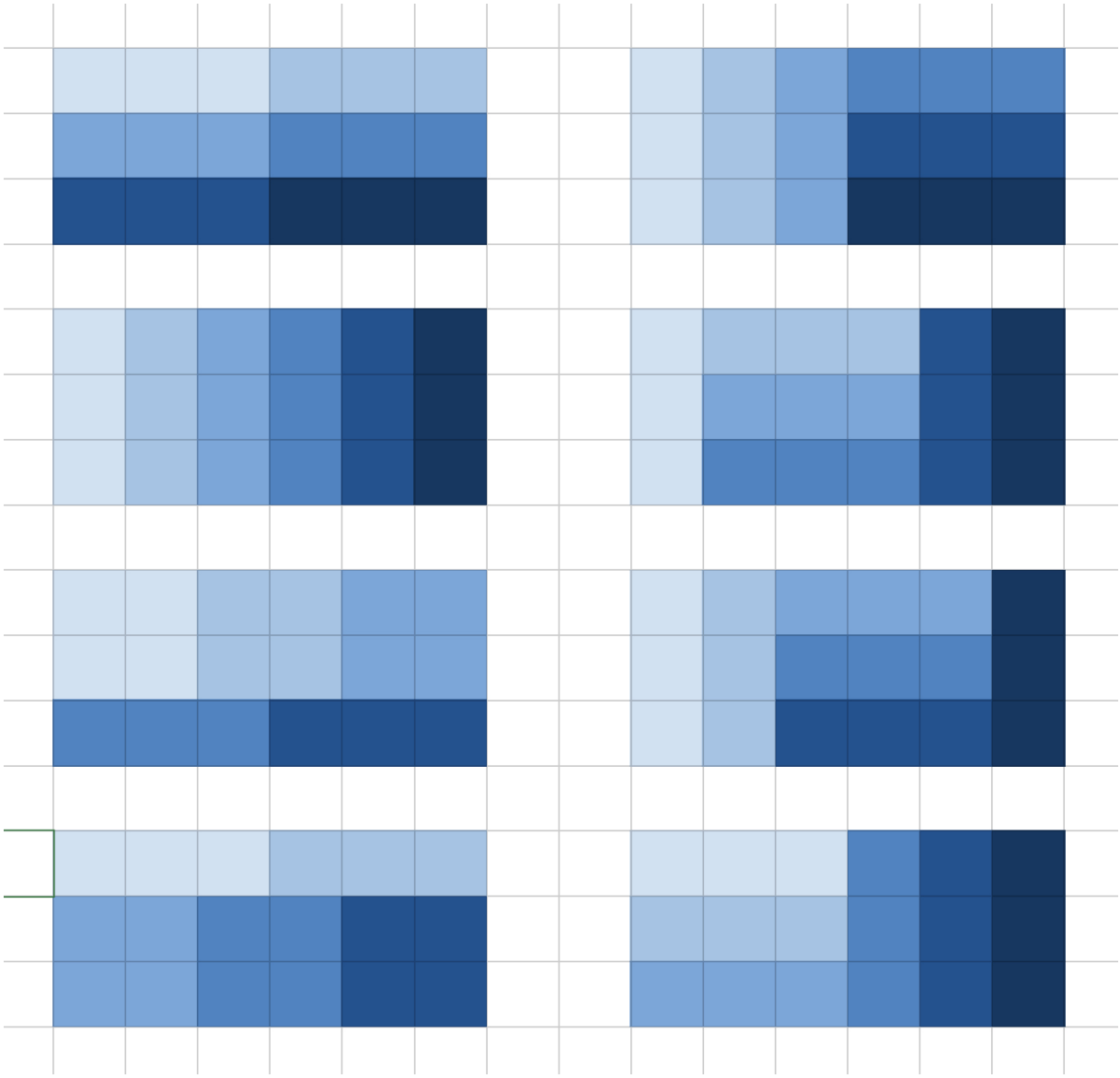


Figure 2: As can been seen above, there are 8 ways to split the bar.