

Problem 8: Put the Fries in the Bag

5+4+6 Points

Problem ID: `fries`

Rank: 2+3+4

Introduction

Big Ben, having graduated from [UC Berkeley](#), has used his [hard-earned degree](#) to serve at the drive-thru at McAlico's. With their patented McCursion Fries™ (so good you'll keep coming back for more!), they're sure to beat out their competition: renowned fast-food diner Oski Bearer.

Now he just has to make sure he doesn't reach in too far and fall into [McWonderland](#)!



Problem Statement

You are given a string S denoting a McBlueprint consisting of the following characters:

- Vertical bars $|$ denoting a McFry
- Pairs of parentheses $()$ denoting a McBag, which can contain other characters inside them
- Letter Os o denoting a McCursion Portal, which can be recursively expanded with the entire McBlueprint

For example, if we had the McBlueprint $(o|(|o))$, it can be expanded as follows:

1. $(o|(|o))$
2. $((o|(|o))|(|o|(|o)))$
3. $((o|(|o))|(|o|(|o)))|(|o|(|o))|(|o|(|o)))$
4. ...

Each McFry is contained within some number of layers of McBags. For example, the McFries within 1 layer of McBag are highlighted below:

$(o|(|o))$

The McFries within 2 layers of McBags are highlighted below:

$((o|(|o))|(|o|(|o)))$

The McFries within 3 layers of McBags are highlighted below:

$((o|(|o))|(|o|(|o)))|(|o|(|o))|(|o|(|o)))$

Note that in order to find all of the fries with a large number of layers, you may have to recursively expand the McBlueprint multiple times, as illustrated above.

Find the total number of McFries that are within at most N layers of McBags. Output the value mod $10^9 + 7$.

Input Format

The first line of the input contains a single integer T denoting the number of test cases that follow.

For each test case:

- The first line contains two space-separated integers L N where:
 - L denotes the length of the string S .
 - N denotes the maximum number of layers of McBags.
- The second line contains a string S of length L denoting the McBlueprint.

It is additionally guaranteed that S consists of a valid parenthesis sequence (no unmatched open or closed parentheses).

Output Format

For each test case, output the total number of McFries that are within at most N layers of McBags mod $10^9 + 7$.

Constraints

$$1 \leq T \leq 10$$

Main Test Set

$$2 \leq L \leq 20$$

$$0 \leq N \leq 5$$

Bonus Test Set

Memory Limit: **1 GB**

$$2 \leq L \leq 100$$

$$0 \leq N \leq 10^9$$

Bonus Test Set 2

Memory Limit: **1 GB**

$$2 \leq L \leq 5000$$

$$0 \leq N \leq 10^9$$

Sample Test Cases

Sample Input

[Download](#)

```
5
7 1
( | | ( | ) )
14 2
( ( | | ( | ) | ) | ( | ) )
8 5
( | ( ( O ) ) )
5 3
( | O O )
6 5
( O ( | ) )
```

Sample Output

[Download](#)

```
2
5
2
7
4
```

Main Sample Explanations

For test case #1, there are 2 fries within exactly 1 McBag and 1 fry within exactly 2 McBags. Therefore, you can grab at most 2 fries within at most 1 McBag.

For test case #4, the portals can be replaced by copies of the outermost bag as follows:

```
( | O O )
( | ( | O O ) ( | O O ) )
( | ( | ( | O O ) ( | O O ) ) ( | ( | O O ) ( | O O ) ) )
```

This representation has 1 fry within 1 McBag, 2 fries within 2 McBags, and 4 fries within 3 McBags for a total of 7 fries within at most 3 McBags.