B. XOR Palindromes

time limit per test: 1 second
memory limit per test: 256 megabytes
input: standard input
output: standard output

You are given a binary string s of length n (a string that consists only of 0 and 1). A number x is good if there exists a binary string l of length n, containing x ones, such that if each symbol s_i is replaced by $s_i \oplus l_i$ (where $\oplus$ denotes the bitwise XOR operation), then the string s becomes a palindrome.

You need to output a binary string t of length $n+1$, where t_i $(0 \le i \le n)$ is equal to 1 if number i is good, and 0 otherwise.

A palindrome is a string that reads the same from left to right as from right to left. For example, `01010`, `1111`, `0110` are palindromes.

Input

Each test contains multiple test cases. The first line contains the number of test cases t $(1 \le t \le 10^5)$. The description of the test cases follows.

The first line of each test case contains a single integer n $(1 \le n \le 10^5)$.

The second line of each test case contains a binary string s of length n.

It is guaranteed that the sum of n over all test cases does not exceed 10^5.

Output

For each test case, output a single line containing a binary string t of length $n+1$ - the answer to the problem.

Example

input Copy

```
5
6
101011
5
00000
9
100100011
3
100
1
1
```

output Copy

```
0010100
111111
0011111100
0110
11
```

Note

Consider the first example.

- $t_2 = 1$ because we can choose $l = 010100$, then the string s becomes 111111, which is a palindrome.
- $t_4 = 1$ because we can choose $l = 101011$.
- It can be shown that for all other i, there is no answer, so the remaining symbols are 0.

Codeforces Round 897 (Div. 2)
Finished
Practice

→ **Virtual participation**

Virtual contest is a way to take part in past contest, as close as possible to participation on time. It is supported only ICPC mode for virtual contests. If you've seen these problems, a virtual contest is not for you - solve these problems in the archive. If you just want to solve some problem from a contest, a virtual contest is not for you - solve this problem in the archive. Never use someone else's code, read the tutorials or communicate with other person during a virtual contest.

Start virtual contest

→ **Clone Contest to Mashup**

You can clone this contest to a mashup.

Clone Contest

→ **Submit?**

Language: GNU G++20 13.2 (64 bit, win

Choose file: Choose File No file chosen

Submit

→ **Last submissions**

Submission	Time	Verdict
235473999	Dec/03/2023 09:30	Accepted
235473242	Dec/03/2023 09:23	Wrong answer on test 1

→ **Problem tags**

bitmasks constructive algorithms strings *1100

No tag edit access

→ **Contest materials**

- Announcement
- Editorial (en)