Kick Start 2022 - Round A

Palindrome Free Strings

Problem

You are given a string $\mathbf{S}$ consisting of characters `0`, `1`, and `?`. You can replace each `?` with either `0` or `1`. Your task is to find if it is possible to assign each `?` to either `0` or `1` such that the resulting string has no substrings that are palindromes of length 5 or more.

Input

The first line of the input gives the number of test cases, $\mathbf{T}$. $\mathbf{T}$ test cases follow.

Each test case consists of two lines.
The first line of each test case contains an integer $\mathbf{N}$, denoting the length of the string $\mathbf{S}$.
The second line of each test case contains a string $\mathbf{S}$ of length $\mathbf{N}$.

Output

For each test case, output one line containing `Case #`x`:` y, where x is the test case number (starting from 1) and y is `POSSIBLE` if there is a possible resulting string that has no palindromic substrings of length 5 or more, or `IMPOSSIBLE` otherwise.

Limits

Memory limit: 1 GB.
$1 \le \mathbf{T} \le 100$.
$\mathbf{S}$ only consists of characters `0`, `1` and `?`.

Test Set 1

Time limit: 20 seconds.
$1 \le \mathbf{N} \le 15$.

Test Set 2

Time limit: 90 seconds.
$1 \le \mathbf{N} \le 5 \times 10^4$.

Sample

Sample Input

```
2
9
100???001
5
100??
```

Sample Output

```
Case #1: IMPOSSIBLE
Case #2: POSSIBLE
```

In Sample Case #1, to prevent the whole string from being a palindrome, the first and last question mark must be different characters.

If we replace first question mark with `0` and replace the last question mark with `1`, we get `1000?1001`. If the remaining `?` is replaced by `1`, we get 100011001, then the first 5 characters form a palindrome of length 5. Otherwise, we get `100001001`, the first 6 characters are a palindrome of length 6.

If we replace first question mark with `1` we get 1001?0001. If the remaining `?` is replaced by `1`, we get 100110001, then the last 5 characters form a palindrome of length 5. Otherwise, we get `100100001`, the last 6 characters are a palindrome of length 6.

Hence, there is no way to get a valid string.

In Sample Case #2, one of the valid strings after replacing all the `?` is `10011`.