CS1020E | Lab 10 | Exercise 2

Binary Substring

Objectives

The focus of this exercise is algorithm efficiency and time complexity.

Problem Description

A binary string is a string where each character is either '0' or '1'. A binary string *S* is *good* if and only if for *every* substring of *S*, the number of '0's is less than or equal to the number of '1's.

A substring of string *S* can be obtained by deleting several (or zero) characters from the beginning of *S* and several (or zero) characters from the end of *S*, leaving at least two characters from *S*. For example, if *S* = "abcdfab", then "abcd", "fab", "bcdfa", "abcdfab" are substrings of *S*, while "abab", "", "d", and "adcdab" are not substring of *S*.

You will be given a binary string of length *N*. You must check whether the binary string is good or not.

Add your code only to the parts of the file indicated. Do not modify any other part of the given code, and do not add new files.

Inputs

The first integer will consist of an integer *T*, the number of binary strings you will check, and 1 <= *T* <= 10. Next, *T* lines follow, each line consists of an integer *N* followed by *N* characters representing the string. 1 <= *N* <= 100,000.

Outputs

For each case, if the binary string is good, output a line containing only "YES", otherwise output a line containing only "NO".

Sample Input

```
2
5 11101
9 101011100
```

Sample Output

```
YES
NO
```

Explanation

In the second example, the binary string is not good because it has a substring "010", in which the number of '0's is more than the number of '1's.

Additional Requirement

An efficient program is required. You can get **100% of the marks** only if your program's time complexity for each input binary string is O(N), otherwise **at most 80% of the marks** if it is better or equal to O(N^2), or **at most 50% of the marks** if it is worse than O(N^2).

Submission

You need to submit your completed **`substring.cpp`** to CodeCrunch (https://codecrunch.comp.nus.edu.sg/) before the specified deadline. We will take only your latest submission.

Late submissions will not be accepted. The submission system in CodeCrunch will automatically close at the deadline.