7006 Folding a Binary String

The two-dimensional grid lattice with diagonals is the infinite graph $\mathcal{L}_{2D} = (V, E)$ with vertex set $V = \mathbb{Z}_2$ and edge set $E = \{\{x, x'\} | x, x' \in \mathbb{Z}_2, |x - x'|_2 \leq \sqrt{2}\}$, where $|\cdot|_2$ denotes the Euclidean norm. Fig. 5 illustrates a two-dimensional grid lattice with diagonals.

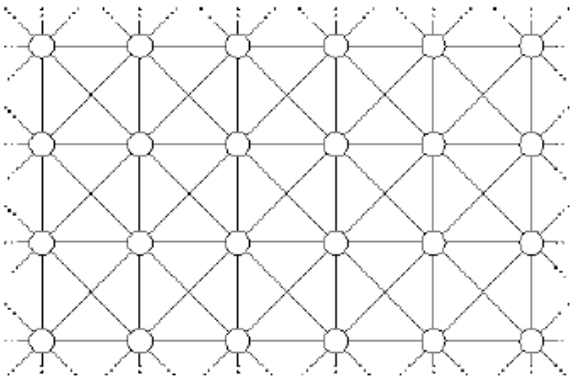

Figure 5: A two-dimensional grid lattice with diagonals

Let $p = p_1 p_2 \ldots p_m$ be a binary string of length m over the alphabet $\{0, 1\}$, and let $\mathcal{L} = (V, E) \in \mathcal{L}_{2D}$ be a lattice. An *embedding* of p into $\mathcal{L}$ is an injective function $\phi : \{1, 2, \ldots, m\} \to V$ from the positions of the string to the vertices of the lattice that assigns adjacent positions in p to adjacent vertices in $\mathcal{L}$, that is, $\{\phi(i), \phi(i+1)\} \in E$ for all $1 \leq i \leq m-1$. These edges $\{\phi(i), \phi(i+1)\} \in E$ for all $1 \leq i \leq m-1$ are called *binding edges*. An embedding of p into $\mathcal{L}$ is called a *conformation*, if no two binding edges cross each other (see Fig. 6(a)). An edge $\{x, x'\}$ of $\mathcal{L}$ is called a *contact edge*, if it is no binding edge, but there exist $i, j \in \{1, 2, \ldots, m\}$ such that $\phi(i) = x$, $\phi(j) = x'$, and $p_i = p_j = 1$ (see Figs. 6(b) and 6(c)). Fig. 7 illustrates a conformation with 3 contact edges.

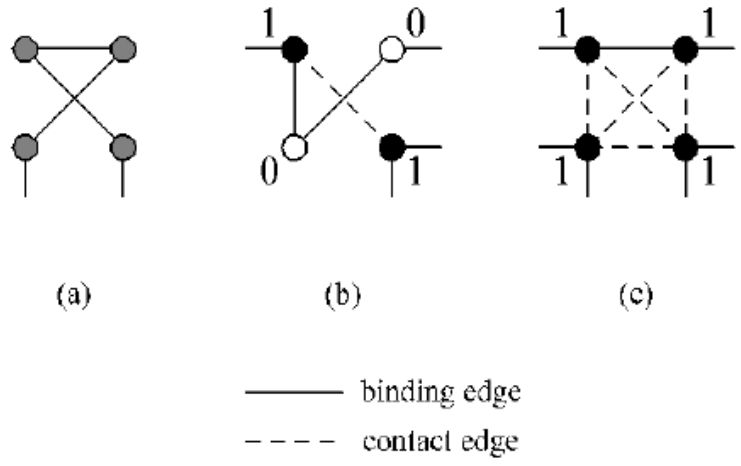

Figure 6: Examples of binding edges and contact edges, where black node represents 1; white node represents 0; gray node can represent 0 or 1; the bold edges represent the binding edges, and the dotted edges represent the contact edges. (a) A forbidden pattern (two binding edges cross each other). (b) A valid pattern with one contact edges. (c) A valid pattern with five contact edges.

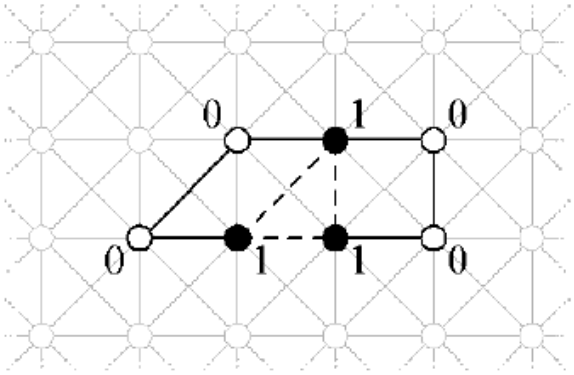

Figure 7: A conformation of the sequence 1001001. The number of contact edges of this conformation equals 3.

A conformation of a given binary string in the lattice $\mathcal{L}_{2D}$ is *optimal* if it contributes the maximum number of contact edges. Given a string $p = p_1p_2 \ldots p_m$ of length m over the alphabet $\{0, 1\}$, your task is to write a computer program to compute the maximum number of contact edges (i.e., the number of contact edges in an optimal conformation).

Technical Specification

- $2 \leq m \leq 11$.

Input

The first line of the input contains a positive integer, denoting the number of test cases to follow. There are at most 12 test cases. For each test case, there are two lines: the first line contains a positive integer m, where m is the number of symbols in the given string and the second line represents the string.

Output

For each test case, output the maximum number of contact edges in one line.

Sample Input

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2
4
1111
7
1001001
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Sample Output

```
3
3
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