

IOI Training Camp 2010 – Test 4, 21 June, 2010

Problem 1 RNA

An RNA molecule is given by a pair of equal length sequences $\langle s_1 s_2 \dots s_n, p_1 p_2 \dots p_n \rangle$ where each s_i is one of the four letters $\{\text{A, U, G, C}\}$ and each p_i is one of $\{ (,), * \}$, such that the parentheses in $p_1 p_2 \dots p_n$ are balanced. In other words, after ignoring all the $*$'s that appear in the sequence $p_1 p_2 \dots p_n$, every opening parenthesis $($ is paired up in a unique way with a closing parenthesis $)$ to its right and, symmetrically, every closing parenthesis $)$ is paired up in a unique way with an opening parenthesis $($ to its left.

For instance, $\langle \text{ACCCGAACUU}, ((**)(**)) \rangle$ and $\langle \text{AAUAUCCCGAAU}, *(**)(**)*() \rangle$ are both RNA molecules, while $\langle \text{ACCCGAACU}, ((**)(**)) \rangle$ and $\langle \text{CCCGAA}, (**)*() \rangle$ are not RNA molecules, because in each of these the parentheses in the second sequence are not balanced.

An RNA molecule $\hat{M} = \langle \hat{s}_1 \hat{s}_2 \dots \hat{s}_m, \hat{p}_1 \hat{p}_2 \dots \hat{p}_m \rangle$ is a submolecule of another RNA molecule $M = \langle s_1 s_2 \dots s_n, p_1 p_2 \dots p_n \rangle$ if there is an index i , $1 \leq i \leq n-m+1$, such that $\hat{s}_1 \hat{s}_2 \dots \hat{s}_m = s_i s_{i+1} \dots s_{i+m-1}$ and $\hat{p}_1 \hat{p}_2 \dots \hat{p}_m = p_i p_{i+1} \dots p_{i+m-1}$. Observe that since \hat{M} is an RNA molecule, $\hat{p}_1 \hat{p}_2 \dots \hat{p}_m$ must have balanced parentheses.

For instance, the RNA molecule $\langle \text{CCCGA}, (**)* \rangle$ is a submolecule of both $\langle \text{ACCCGAACUU}, ((**)(**)) \rangle$ and $\langle \text{AAUAUCCCGAAU}, *(**)(**)*() \rangle$.

Given a pair of RNA molecules $M = \langle s_1 s_2 \dots s_n, p_1 p_2 \dots p_n \rangle$ and $M' = \langle s'_1 s'_2 \dots s'_k, p'_1 p'_2 \dots p'_k \rangle$ the task is to identify the length k of the longest RNA molecule $\langle \hat{s}_1 \hat{s}_2 \dots \hat{s}_k, \hat{p}_1 \hat{p}_2 \dots \hat{p}_k \rangle$ that is a submolecule of both M and M' .

Input format

The first line input contains two integers X and Y , specifying the length of the first and second molecule respectively.

The second and third lines of input are strings of length X describing the first RNA molecule. The string in the second line is made up of letters from $\{\text{A, T, G, C}\}$ and the string in the third line is made up of letters from $\{ (,), * \}$, with balanced parentheses.

Similarly, the fourth and fifth lines of input are strings of length Y , describing the second RNA molecule.

Output format

A single line with an integer that is the length of the longest common sub-molecule.

Test Data

You may assume that $1 \leq X, Y \leq 2500$.

Example

Here is the sample input and output corresponding to the example above.

Sample input

```
12 10
AAUAUCCCGAAU
*(**)(**)*()
ACCCGAACUU
((**)*(**))
```

Sample output

```
5
```

Time and memory limits

The time limit for this task is 2 seconds. The memory limit is 44 MB (actual limit 32 MB, plus 12 MB buffer for 64-bit compilation).