Task: TPE
Terrible Periodic Encryption

AACPP SuSe 2024 Round 5 Memory: 128MiB 2024.06.25 – 2024.07.09

Byteman is an avid cryptography enthusiast in his spare time. He found archived communications on a defunct IT Task Force server, apparently encrypted with a long defunct encryption algorithm. It didn't take long for Byteman to realise the cypher is *terrible* – many messages are *periodic*, which makes them much easier to crack.

Byteman wants to analyse the communications for periodicity. A word w has a *period* u if w is equal to a repetition of u one or more times (in other words, $w = u^k$ for some $k \geq 1$). For example, ababab has two periods, ab and ababab itself. Note that, in particular, a word is always its own period. To minimise the decryption workload we are interested in *shortest periods* of words.

The archive is given as a string of lowercase letters from the English alphabet. Byteman is interested in q contiguous substrings of the archive to analyse. Help Byteman crack the code and for each such substring output the length of its shortest period.

Input

In the first line of standard input there are two integers n, q, the length of the archive string and the number of substring queries, respectively.

The second line contains a string of n lowercase English alphabet characters. Positions in the string are numbered from 1 to n.

The final q lines contain queries. Each line contains two integers a_i, b_i, $1 \leq a_i \leq b_i \leq n$, representing a query for the substring starting at position a_i and ending at b_i (inclusive).

Output

Your program should write q lines to standard output. The i-th line should contain the length of the minimal period of the substring represented by a_i, b_i.

Example

For the input:

```
8 3
aaabcabc
1 3
3 8
4 8
```

the correct output is:

```
1
3
5
```

Additional examples

The following initial tests are also available:

- `0b` – small test for Subtask 1, $n = 15$, $q = 9$, word is $\mathrm{ykdyykdyykdyykd}$;
- `0c` – Subtask 2, $n = 10^4$, $q = 10^4$, word is a random binary word, in all queries $b = a + 20$;

- `0d` – Subtask 3, $n = 99{,}996$, $q = 10^5$, word is $\mathrm{abcdefghijklmnopqrstuvwxyz}$ repeated, in each query $a_i \equiv 0 \bmod 26$;
- `0e` – big test, $n = 5 \cdot 10^5$, $q = 1{,}999{,}979$, word is all a, queries for all prefixes, all suffixes, all subwords of length 2, all subwords of length 20.

Limits

Your solution will be evaluated on a number of hidden test cases divided into groups. Points for a group are awarded if and only if the submission returns the correct answer for each of the tests in the group within the allotted time limit. These groups are organised into subtasks with the following limits and points awarded.

Subtask	Limits	Points
1.	$1 \leq n, q \leq 250$	2
2.	$1 \leq n, q \leq 10^4$	2
3.	$1 \leq n, q \leq 10^5$	2
4.	$1 \leq n \leq 5 \cdot 10^5$, $1 \leq q \leq 2 \cdot 10^6$	4