Virus Sequencing (dna)

Luca is working in an important analysis laboratory, and he is currently studying the various variants of the coronavirus. In particular, N different variants of the virus have been sequenced. That is, for each variant, its genome is described as an M characters long sequence S_i, composed only of zeros and ones.

Figure 1: The laboratory where Luca is working.

Luca needs to upload all these binary sequences to a central server as soon as possible, so that all the other laboratories around the world can access them.

For each sequence S_i, he can either upload the whole sequence or only the differences between S_i and another sequence that has already been uploaded. In the first case, he needs to upload M bits, in the second case he only needs to upload one bit for every position in which the two sequences differ.

What is the minimum number of bits he has to transfer in order to upload the genome of all the variants?

☞ Among the attachments of this task you may find a template file `dna.*` with a sample incomplete implementation.

Input

The first line contains two integers N and M, respectively the number of variants and the length of the genome of each variant. Then N lines follow, the i-th of which containing one binary sequence S_i, that is the genome of the i-th variant.

Output

You need to write a single line with an integer: the minimum number of bits that Luca has to transfer.

Constraints

- $1 \leq N \leq 9\,000$.
- $1 \leq M \leq 100$
- S_i is a sequence composed of exactly M characters, each of them being either 0 and 1.
- $S_i \neq S_j$ for every $i \neq j$.

Scoring

Your program will be tested against several test cases grouped in subtasks. In order to obtain the score of a subtask, your program needs to correctly solve all of its test cases.

– **Subtask 1** (0 points) Examples.

– **Subtask 2** (14 points) $N \leq 9$, $M \leq 10$.

– **Subtask 3** (11 points) $N \leq 10$, $M \leq 25$.

– **Subtask 4** (15 points) $N \leq 20$, $M \leq 25$.

– **Subtask 5** (22 points) $N \leq 1000$, $M \leq 25$ and for each $i = 1 \ldots N-1$ there exists $j = 0 \ldots i-1$ such that S_i and S_j have exactly one different character.

– **Subtask 6** (31 points) $N \leq 1000$, $M \leq 25$.

– **Subtask 7** (7 points) No additional limitations.

Examples

input	output
4 4 1111 0000 0011 1100	10
2 4 1011 0100	8

Explanation

In the **first sample case**, Luca can do the following:

- Upload the first sequence, transferring $M = 4$ bits;
- Upload the differences between the third and the first sequence, transferring 2 bits;
- Upload the differences between the fourth and the first sequence, transferring 2 bits;
- Upload the differences between the second and the fourth sequence, transferring 2 bits;

He cannot do better than this and he has to transfer $4 + 2 + 2 + 2 = 10$ bits.

In the **second sample case** the two sequences never have the same character in the same position, so both of them must be fully uploaded, for a total of 8 bits.