Selection Contest for ACM-HK Programming Contest 2019

The University of Hong Kong

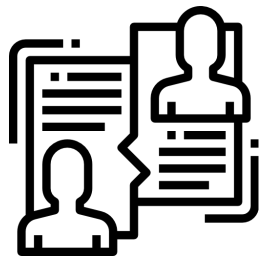
April 27, 2019

Important Notes

- The contest begins at **2:00 pm** and lasts for **150 minutes**, ending at **4:30 pm**.
- The problem set consists of **6 problems**. The problems may not be ordered by difficulty.
- Printed and written notes are allowed, while internet access is prohibited.
- Please use **standard input/output** (e.g. `scanf/printf`, `cin/cout` or `System.in/` `System.out.print`) and do not print anything other than those required in the problem.

Problem A — limit 1 second

Exam



Your friend and you took a true/false exam of n questions. You know your answers, your friend's answers, and that your friend got k questions correct.

Compute the maximum number of questions you could have gotten correctly.

Input

The first line of input contains a single integer k.

The second line contains a string of n ($1 \leq n \leq 1000$) characters, the answers you wrote down. Each letter is either a 'T' or an 'F'.

The third line contains a string of n characters, the answers your friend wrote down. Each letter is either a 'T' or an 'F'.

The input will satisfy $0 \leq k \leq n$.

Output

Print, on one line, the maximum number of questions you could have gotten correctly.

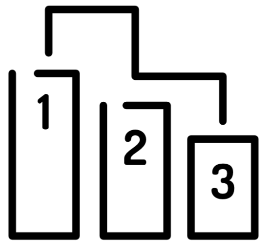
Sample Input and Output

3 FTFFF TFTTT	2

6 TTFTFFTFTF TTTTFFTTTT	9

Problem B — limit 1 second

Contest Setting



A group of contest writers have written n problems and want to use k of them in an upcoming contest. Each problem has a *difficulty level*. A contest is valid if all of its k problems have different difficulty levels.

Compute how many distinct valid contests the contest writers can produce. Two contests are distinct if and only if there exists some problem present in one contest but not present in the other.

Print the result modulo 998,244,353.

Input

The first line of input contains two space-separated integers n and k ($1 \leq k \leq n \leq 1000$).

The next line contains n space-separated integers representing the difficulty levels. The difficulty levels are between 1 and 10^9 (inclusive).

Output

Print the number of distinct contests possible, modulo 998,244,353.

Sample Input and Output

`5 2` `1 2 3 4 5`	`10`

`5 2` `1 1 1 2 2`	`6`

12 5 3 1 4 1 5 9 2 6 5 3 5 8	316

Problem C — limit 1 second

Count The Bits

Given an integer k and a number of bits b ($1 \le b \le 128$), calculate the total number of 1 bits in the binary representations of multiples of k between 0 and $2^b - 1$ (inclusive), modulo 1,000,000,009.

Input

The input will consist of two integers k and b on a single line, with $1 \le k \le 1000$ and $1 \le b \le 128$.

Output

Write your result as an integer on a single line.

Sample Input and Output

1 4	32
10 5	8
100 7	3
3 28	252698795

11 128	856188165

1 26	872415232

876 128	530649653

Problem D — limit 5 seconds

Cops And Robbers

The First Universal Bank of Denview has just been robbed! You want to catch the robbers before they leave the state of Calirado.

The state of Calirado is a perfect grid of size m-by-n. The robbers will try to escape by going from grid square to grid square (only through edges, not corners) until they reach the border of the state.

You can barricade some grid squares to stop the robbers from using them. However, depending on the terrain, different grid squares may cost different amount of money, and some grid squares may not be barricaded at all!

Find the cheapest set of grid squares to barricade that guarantees no escape for the robbers.

Input

The first line of input contains three space-separated integers n, m, and c ($1 \leq n, m \leq 30$, and $1 \leq c \leq 26$), where n and m are the dimensions of the grid, and c is the number of types of terrain in Calirado.

Each of the next m lines contains n letters each, representing the grid.

- Character '`B`' indicates the First Universal Bank of Denview; it is where the robbers currently are.
- Characters '`a`' through '`z`' represent the different types of terrain. Only the first c alphabets will appear in the grid.
- A dot ('`.`') represents a grid square that cannot be barricaded.

It is guaranteed that the grid will contain exactly one `B` character.

Finally, the last line of the input contains c space-separated integers between 1 and 100,000 (inclusive), representing the cost of barricading a single grid square of type '`a`', '`b`', and so on.

Output

Print, on one line, the minimum total cost of barricading plan that guarantees no exit for the robbers.

If there is no way to prevent the robbers from escaping, print `-1` instead.

In the first example, the minimum cost is to barricade the central three squares on each side for a total cost of 12.

In the second example, since the bank is on the border, and we cannot barricade the bank, there is no way to prevent the robbers from escaping the state.

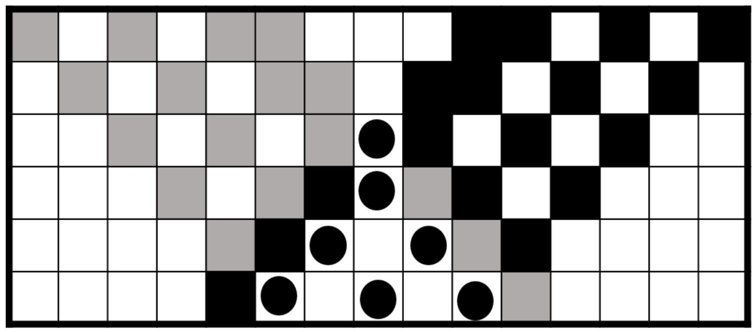
Sample Input and Output

Input	Output
5 5 1 aaaaa a...a a.B.a a...a aaaaa 1	12

Input	Output
2 2 1 aB aa 1	-1

Problem E — limit 1 second

Repeating Goldbachs



The Goldbach Conjecture states that any even number $x \geq 4$ can be expressed as the sum of two primes. It can be verified that the conjecture is true for all $x \leq 10^6$.

Define a *Goldbach step* as taking x ($4 \leq x \leq 10^6$), finding primes p and q (with $p \leq q$) that sum to x, and replacing x with $q - p$. If there are multiple pairs of primes which sum to x, we take the pair with the largest difference. That difference must be even and less than x. Therefore, we can repeat more Goldbach steps, until we can reach a number less than 4.

Given x, find how many Goldbach steps it takes until reaching a number less than 4.

Input

The input will consist of a single integer x ($4 \leq x \leq 10^6$).

Output

Print, on a single line, the number of Goldbach steps it takes to reach a number less than 4.

Sample Input and Output

20	3
30	4
40	5

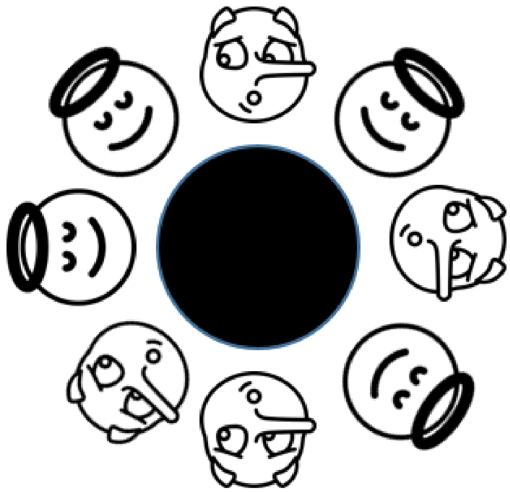
50	6

60	7

70	8

Problem F — limit 1 second

Liars



There are n people in a circle, numbered from 1 to n, each of whom always tells the truth or always lies.

Each person i makes a claim of the form: "the number of truth-tellers in this circle is between a_i and b_i, inclusive."

Compute the maximum number of people who could be telling the truth.

Input

The first line contains a single integer n ($1 \leq n \leq 10^3$). Each of the next n lines contains two space-separated integers a_i and b_i ($0 \leq a_i \leq b_i \leq n$).

Output

Print, on a single line, the maximum number of people who could be telling the truth. If the given set of statements is inconsistent, print `-1` instead.

Sample Input and Output

3 1 1 2 3 2 2	2

8 0 1 1 7 4 8 3 7 1 2 4 5 3 7 1 8	-1