Problem A
Treehouses

In a rainforest there are n treehouses high in the forest canopy on different trees (numbered from 1 to n). The i-th tree's location is at (x_i, y_i). The first e of them in the list are close enough to neighboring open land around the rainforest so that transportation between all of them is easy by foot. Some treehouses may already be connected by direct straight cables through the air that can allow transport between them.

Residents want easy transportation between all the treehouses and the open land, by some combination of walking (between those near the open land), and using one or more cables between treehouses. This may require the addition of more cables. Since the cables are expensive, they would like to add the smallest possible length of cable.

The height of a cable up two trees can be set so cables can criss-cross other cables, and not allow any snags or crashes. It is not safe to try to switch between two criss-crossed cables in mid-air!

Input

The input will start with the three integers n ($1 \le n \le 1\,000$), e ($1 \le e \le n$), and p ($0 \le p \le 1\,000$), where p is the number of cables in place already.

Next come n lines, each with two real numbers x and y ($|x|, |y| \le 10\,000$) giving the location of a treehouse. The i-th coordinate pair is for the treehouse with ID i. All coordinate pairs are unique. Real numbers are stated as integers or include one digit after a decimal point.

Next come p lines, each with two integers a, b, where $1 \le a < b \le n$, giving the two treehouse ids of an existing cable between their trees. No ID pair will be repeated.

Output

The output is the minimum total length of new cable that achieves the connection goal, expressed with absolute or relative error less than 0.001.

Sample Input 1	Sample Output 1
3 1 0 0.0 0.0 2.0 0.0 1.0 2.0	4.236

Sample Input 2

3 1 1 0.0 0.0 0.5 2.0 2.5 2.0 1 2

Sample Output 2

2.000

Sample Input 3

3 2 0 0.0 0.0 2.0 0.0 1.0 2.0

Sample Output 3

2.236

Problem B
Exam

Your friend and you took the same true/false exam. You know your answers, your friend's answers, and the number of your friend's answers that were correct.

Compute the maximum possible score you could have gotten.

Input

The first line contains a single integer k, the number of correct answers on your friend's exam.

The second line contains a string of characters, the answers you wrote down. Each letter is either a 'T' or an 'F'. The length of the string is the number n of exam questions.

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

Bounds are $0 \leq k \leq n \leq 1\,000; 1 \leq n$.

Output

The output is one line containing the maximum number of questions you could have gotten correct.

Sample Input 1	Sample Output 1
3 FTFFF TFTTT	2

Sample Input 2	Sample Output 2
6 TTFTFFTFTF TTTTFFTTTT	9

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Problem C
Cops and Robbers

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

The state of Calirado can be represented by a rectangular n-by-m grid of characters, with the character in each grid cell denoting a terrain type. The robbers begin within the cell marked 'B', indicating the Bank of Denview. They will then travel across the state by moving from grid cell to grid cell in the four cardinal directions (left, right, up, down). (Note that the robbers pass only through grid edges, and not corners.) If the robbers manage to leave the state (by crossing any boundary edge of the grid) they will go into hiding, never to be seen again. You must stop this.

To catch the robbers, you can set up barricades. Barricades are placed inside a grid cell, and prevent the robbers from traveling into the cell (from any direction). Each grid square consists of a different type of terrain, with different cost for placing a barricade. You cannot place a barricade on the bank ('B') or on any cell containing a dot ('.'), though the robbers can travel freely through these cells. Every other cell will contain a lowercase English letter, indicating a terrain type.

Find the cheapest way to prevent the robbers from escaping Calirado.

Input

The first line contains three integers n, m, and c ($1 \leq n, m \leq 30$, $1 \leq c \leq 26$): the dimensions of the grid representing Calirado, and the number of different terrain types. Then follows m lines of exactly n characters each: the map of Calirado. Each character is either 'B', '.', or one of the first c lowercase letters of the English alphabet. Calirado is guaranteed to contain exactly one bank. After the grid, there is a line containing c space-separated integers $1 \leq c_i \leq 100\,000$, the costs of placing a barricade on a grid cell of each terrain type. c_1 is the cost for terrain type 'a', c_2 is the cost for 'b', and so forth.

Output

Print one integer, the minimum total cost of the barricades that you need to place to prevent the robbers from escaping. 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 of the bank for a total cost of 12.

In the second example, since the bank is on the border, there is no way to prevent the robbers from escaping the state.

In the third example, we must prevent the robbers from leaving the bank to the top, bottom, and right, or else we cannot prevent them from leaving the state. To the left, however, it is cheaper to allow passage through the 'b' cell, and then barricade in each of the three directions from there. The total cost is $7 + 5 + 7 + 3(1) = 22$.

Sample Input 1

```
5 5 1
aaaaa
a...a
a.B.a
a...a
aaaaa
1
```

Sample Output 1

```
12
```

Sample Input 2

```
2 2 1
aB
aa
1
```

Sample Output 2

```
-1
```

Sample Input 3

```
4 3 3
.abc
abBc
.abc
1 7 5
```

Sample Output 3

```
22
```

Problem D
Poker Hand

You are given a five-card hand drawn from a standard 52-card deck. The strength of your hand is the maximum value k such that there are k cards in your hand that have the same rank.

Compute the strength of your hand.

Input

The input will consist of a single line, with five two-character strings separated by spaces.

The first character in each string will be the rank of the card, and will be one of `A23456789TJQK`. The second character in the string will be the suit of the card, and will be one of `CDHS`.

You may assume all the strings are distinct.

Output

Output, on a single line, the strength of your hand.

Sample Input 1	Sample Output 1
`AC AD AH AS KD`	`4`

Sample Input 2	Sample Output 2
`2C 4D 4H 2D 2H`	`3`

Sample Input 3	Sample Output 3
`AH 2H 3H 4H 5H`	`1`

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Problem E
Coprime Integers

Given intervals $[a, b]$ and $[c, d]$, count the number of ordered pairs of co-prime integers (x, y) such that $a \leq x \leq b$ and $c \leq y \leq d$. Coprime integers have no common factor greater than 1.

Input

The input consists of a single line of four space-separated integers a, b, c, and d. These integers satisfy the bounds ($1 \leq a \leq b \leq 10^7$, $1 \leq c \leq d \leq 10^7$).

Output

Print a single integer: the number of coprime pairs (x, y) with $a \leq x \leq b, c \leq y \leq d$.

Sample Input 1	Sample Output 1
1 5 1 5	19

Sample Input 2	Sample Output 2
12 12 1 12	4

Sample Input 3	Sample Output 3
1 100 1 100	6087

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Problem F
Goat Rope

You have a fence post located at the point (x, y) in the plane, to which a goat is tethered by a rope. You also have a house, which you model as an axis-aligned rectangle with diagonally opposite corners at the points (x_1, y_1) and (x_2, y_2). You want to pick a length of rope that guarantees the goat cannot reach the house.

Determine the minimum distance from the fence post to the house, so that you can make sure to use a shorter rope.

Input

The input consists of a single line containing six space-separated integers x, y, x_1, y_1, x_2, and y_2, each in the range $[-999, 999]$.

It is guaranteed that $x_1 < x_2$ and $y_1 < y_2$, and that (x, y) is strictly outside the axis-aligned rectangle with corners at (x_1, y_1) and (x_2, y_2).

Output

Print the minimum distance from the goat's post to the house, with a relative or absolute error no more than 0.001.

Sample Input 1	Sample Output 1
7 3 0 0 5 4	2.0

Sample Input 2	Sample Output 2
6 0 0 2 7 6	2.0

Sample Input 3	Sample Output 3
3 -4 -3 -1 -1 2	5.0

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Problem G
Illiteracy

Illiteracy is a simple puzzle game created by Le Sio. [1] The game consists of a sequence of eight icons; the actual icons are very artistic, but for simplicity, we'll label the icons using a capital letter A—F. Clicking any icon has a unique effect on the other icons, based on which icon is clicked and that icon's position in the sequence. Most of the icons *rotate* the type of other icons. A rotation changes an A to a B, B to C, C to D, D to E, E to F, and F back to A.

Here's what the icons do when you click on one, based on the type of the icon and its position x in the sequence ($1 \leq x \leq 8$):

Type	Effect
A	Rotates the icons immediately to the left and right (at positions $x - 1$ and $x + 1$), ignoring any icon that doesn't exist (when $x = 1$ or 8).
B	If the icon is at either end of the sequence, does nothing. Otherwise, changes the icon at position $x + 1$ to the same type as the current icon at $x - 1$.
C	Rotates the icon at position $9 - x$.
D	Rotates all icons between position x and the closest of the sequence's two ends. (Does nothing if x is one of the two ends, and does not change the icon at position x itself). For example, if $x = 3$, the icons at $x = 1$ and 2 would be rotated. If $x = 5$, then the icons at positions 6, 7, and 8 would be rotated.
E	If the icon is at either end of the sequence, does nothing. Otherwise, let y be the number of icons between position x and the closest of the sequence's two ends. Rotates the two icons at positions $x - y$ and $x + y$. For example, if $x = 3$, the icons at $x = 1$ and 5 would be rotated. If $x = 5$, the icons at positions 8 and 2 would be rotated.
F	If x is odd, rotates the icon at position $(x + 9)/2$. If x is even, rotates the icon at position $x/2$.

Given a starting sequence of icons and a target sequence, what is the minimal number of clicks required to transform the starting sequence into the target sequence?

Examples For the cases below, we illustrate one possible minimal sequence of clicks to get from the top configuration to the bottom one. The carets indicate which icon on the previous line was clicked to generate the sequence on the following line. The sequence on the left takes 2 clicks; the sequence on the right takes 4 clicks.

```
ABCDEFCD          DCDAFCBA
   ^                 ^
BCDDEFCD          DCEAACBA
    ^                  ^
BCEDEFCD          DCEAACBC
                        ^
```

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[1] After the contest, you can play it at https://le-slo.itch.io/illiteracy.

```
        DCEAACCC
           ^
        ECEABCCC
```

Input

The input consists of exactly two lines of eight characters each. The first line is the starting icon sequence, and the second is the target sequence. Each character on each line is one of the six capital letters A, B, C, D, E, or F. It will always be possible to reach the target sequence from the given starting sequence using a finite number of clicks.

Output

Output a single integer, the smallest number of icon clicks needed to get from the starting sequence to the target sequence.

Sample Input 1	Sample Output 1
ABCDEFCD BCEDEFCD	2

Sample Input 2	Sample Output 2
DCDAFCBA ECEABCCC	4

Sample Input 3	Sample Output 3
ABCDEFCD ABCDEFCD	0

Sample Input 4	Sample Output 4
ACFEFBEB EDBFEFDE	22

Problem H
Heir's Dilemma

Your favorite uncle has passed away, leaving you a large estate. Bank account numbers, locations of safe deposit boxes, and GPS coordinates to buried treasures are all locked in an electronic safe in your uncle's office behind a picture of dogs playing poker. One day he showed you the safe with its 9 digit keypad (digits 1 through 9). He told you he wasn't worried about anyone breaking into his safe because it's equipped with a self-destruct mechanism that will destroy the contents if anyone attempts a forced entry.

The combination is a sequence of six decimal digits. If an incorrect combination is entered the safe enforces a thirty-second delay before accepting another combination. So a brute-force effort to try all six-digit combinations could take months.

Your uncle had planned to give you, his sole heir, the combination one day, but due to an unfortunate hang-gliding accident in Kansas, you now must rely on your deductive and programming skills to access the key to your inheritance.

Here's what you know:

- The combination c is a sequence of six non-zero decimal digits.

- Your mother recalls that she heard your uncle mention that all the digits are different.

- You remember that your uncle once said that the six digit number was divisible by each of its individual digits.

An example satisfying these conditions is 123864: all six digits differ, and you can check that 123864 is divisible by each of $1, 2, 3, 8, 6$ and 4.

Even with the helpful data, it could take a while to get to open the safe, so the task is likely to be split into several sessions with separate ranges being tested. How many combinations are there to try in the range given?

Input

The input is a line with two space-separated integers L and H, where $123\,456 \leq L < H \leq 987\,654$

Output

Print one integer, the total number of possible combinations to the safe, where each combination c must satisfy the three constraints above, and lie in the range $L \leq c \leq H$.

Sample Input 1	Sample Output 1
123864 123865	1

Sample Input 2

198765 198769	0

Sample Output 2

Sample Input 3

200000 300000	31

Sample Output 3

Problem I
Random Manhattan Distance

You are operating a taxi company in the Land of Bytes, which is an interesting city. First, all roads in the city either along the north-south direction or along the east-west direction. Second, it's an extremely large city such that the sizes of blocks between different roads are negligible. Therefore, each position in this city can be represented by coordinates (x, y) of real values.

The taxi drivers always takes the shortest path between the pick-up and drop-off points, following streets. Your company only operates the taxis within the central business district (CBD), which is a convex polygon of n points.

Assuming the pick-up and drop-off points from the passengers are chosen, uniformly at random, from inside the CBD, what is the expected distance that a taxi will travel? Assume the taxi travel distance between any points (x, y) and (x_1, y_1) is always $|x - x_1| + |y - y_1|$.

Input

The first line contains an integer n ($3 \leq n \leq 100\,000$).

Following this will be n lines, each with two integer values values (x, y) representing the points on the border of CBD, where $|x|, |y| < 10^9$. The points are presented in a clockwise order and there will be no three points on the same line.

Output

The output is a single line containing one number, the expected distance expressed with a relative or absolute error less than 10^{-6}.

Sample Input 1	Sample Output 1
4 0 0 0 1 1 1 1 0	0.666666666666667

Sample Input 2	Sample Output 2
3 0 0 1 1 2 0	0.733333333333333

Sample Input 3	Sample Output 3
6 0 0 1 1 3 2 5 1 4 -1 2 -1	2.08448753462604

Problem J
Mobilization

Mobilization is a brand new strategy game in which you are required to mobilize an army. The army can consist of different types of troops, each of which has a cost, health, and potency. You can acquire any combination of the troop types, even fractional, such that the total cost is no more than the amount you have to spend. The efficacy of the army is equal to its total health value multiplied by its total potency. What is the greatest efficacy you can achieve with the given purchasing constraints?

You may assume that there are always sufficient troops available to buy as many as you want (subject to the total constraint).

Input

The first line will contain two integers, the number of different types of troops n ($1 \le n \le 30\,000$ and the total budget you have to spend b ($1 \le b \le 100\,000$).

Following this will be n lines, each with three values for this troop type: an integer value of its unit cost c ($1 \le c \le 100\,000$, a real value of its unit health h ($0 \le h \le 1$), and a real value of its unit potency p ($0 \le p \le 1$). The real values may contain up to 20 digits after the decimal point.

Output

The output is a line containing one number, the greatest possible efficacy expressed with a relative or absolute error less than 0.005.

Sample Input 1	Sample Output 1
4 100000	19436.05
300 1 0.02	
500 0.2 1	
250 0.3 0.1	
1000 1 0.1	

Sample Input 2	Sample Output 2
2 100	3025.00
1 0.1 1	
1 1 0.1	

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Problem K
Repeated Substrings

Given an input string composed solely of lowercase English letters, find the longest substring that occurs more than once in the input string. The two occurrences are allowed to partially overlap.

Input

The input is a single line containing a string of lowercase letters. The string contains more than one character, but no more than 10^5. At least one letter will appear at least twice.

Output

Print a single line of output: the longest substring that occurs more than once in the input string. If there are multiple longest repeated substrings, print the one the would come first when the longest substrings are sorted in lexicographical (alphabetical) order.

Sample Input 1	Sample Output 1
abcefgabc	abc

Sample Input 2	Sample Output 2
abcbabcba	abcba

Sample Input 3	Sample Output 3
aaaa	aaa

Sample Input 4	Sample Output 4
bbcaadbbeaa	aa

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