CS F211
Data Structures and Algorithms
Assignment - 4

Recursion and Miscellaneous

Allowed Language: **C**

January 30, 2024

General Tips

- Try to use functions as much as possible in your code. Functions increase reusability and the pass-by-value feature provides a significant help sometimes. Modularizing your code also helps you to debug efficiently.
- Use `scanf` to read characters/strings from STDIN. Avoid using `getchar`, `getc` or `gets`. Try to read up about character suppression in `scanf` as it will be very helpful in some of the problems.
- Use `printf` instead of `putc`, `putchar` or `puts` to print character/string output on STDOUT.
- Indent your code appropriately and use proper variable names. These increase readability and writability of the code. Also, Use comments wherever necessary.
- Use a proper IDEs like Sublime Text or VSCode as they help to run and test your code on multiple test-cases easily.
- **Note:** Kindly try to do all of these questions by yourself at least once. Spend some time thinking about it, or trying to code it instead of directly asking help of your friends or searching it up online. This helps you understand the question, allowing you to solve further questions which are not in the scope of this Assignment yourself.
- For Problems B-F, please use a **Recursive Algorithm**.

A: Using Numberly

Shimmerun was writing an article on LiFi (Light Fidelity) Technology. Halfway through, she realised that the numbers she wrote were supposed to be written down using the International Number System in the English Language (without any and, and in lower case).

Help Shimmerun make the edits, so that all of you can read about the LiFi Technology.

Input

The first line contains a single non-negative integer n ($0 \leq n \leq 10^{12}$).

Output

A lowercase string representing the integer number above (without any and).

---

input
10

output
ten

---

input
673

output
six hundred seventy three

---

input
1234567

output
one million two hundred thirty four thousand five hundred sixty seven

---

B: Beauty Contest

A-man and Mahi-man along with their $(k-2)$ friends decide to enter a beauty pageant. In order to look good, Mahi-man orders n makeup packets, where i-th packet has a weight a_i. Since the packets are heavy, A-man goes and picks them up. Now he has to distribute them among everyone including himself. Since it is a makeup packet, it cannot be broken into smaller weights. Also, each makeup packet is given to someone for sure.

The beauty of a distribution is defined as the maximum weight of makeup obtained by a single person. Hence, help A-man distribute in such a way that the beauty is minimized over all of the possible distributions (since he hates makeup unlike his friends).

Input

The first line contains 2 integers, n and k $(2 \leq k \leq n \leq 8)$ - the number of makeup packets and the total number of people respectively.
The second line contains n integers $a_1, a_2, \ldots, a_n$ $(1 \leq a_i \leq 10^6)$ - the weights of the makeup packets. These weights need not be unique.

Output

Single integer containing the minimum beauty of all distributions.

```
input
5 2
8 15 10 20 8

output
31
```

Explanation: A-man can take the packets (10,20) and give Mahi-man the packets (8,15,8). So the beauty of this distribution is 31. This is the minimum beauty among all distributions.

```
input
6 3
9 12 7 3 11 20

output
21
```

C: To Take or Not To Take

Tinku is very fond of doing CodeLeet problems. He does almost 10 problems daily. Due to circumstances, he wanted to improve his coding skills, he decided to start solving as many hard problems as possible. Given he has k minutes of free time, a list of ratings of problems he plans to solve and also an estimate for the time he would need to solve this list, find the maximum sum of ratings of problems which he can solve in his free time.

Input

The first line contains a two integers n, k ($1 \leq n \leq 20$; $1 \leq k \leq 10^4$) - number of problems that Tinku plans to solve in his free time (in minutes).
The second line contains n integers $a_1, a_2, \ldots, a_n$ ($1 \leq a_i \leq 2000$) - the ratings of the problems.
The third line contains n integers $t_1, t_2, \ldots, t_n$ ($1 \leq t_i \leq 10^4$) - the time needed to solve the problems (in minutes).

Output

Single integer containing the maximum sum of ratings mentioned in the question.

```
input
3 8
30 50 60
3 4 5

output
90
```

Explanation: He can solve the problems with rating 30, 60 and take use of his full free time 8 minutes, so the maximum sum is 90.

```
input
8 30
100 200 300 400 500 600 700 700
1 2 3 4 5 6 7 7

output
3000
```

D: Nom's Greed

After Nom and Kira fight again, Nom took over Kira's assets in the stock market. Seeing this, Kira decided to ask help from Junji who lives in Delhi Metro. Junji on Kira's command placed a sudoku inside the cash locker every time Nom opened it. Only if he was able to solve the hard sudoku, should he be allowed to steal all of Kira's money. Help Nom become rich.

What is Sudoku: A puzzle in which players insert the numbers one to nine into a grid consisting of nine squares subdivided into a further nine smaller squares in such a way that every number appears once in each horizontal line, vertical line, and square.

Input

Given $n = 9$ lines of input with 9 integers each. Blank space is provided as -1.

Output

The first 9 lines should contain a solved sudoku.

---

input

```
8 -1 2 6 -1 4 -1 -1 -1
-1 -1 1 8 2 3 -1 -1 9
3 4 6 9 -1 -1 7 -1 8
-1 -1 4 -1 9 -1 1 -1 5
-1 3 -1 -1 6 8 9 7 -1
-1 -1 9 -1 1 -1 -1 -1 6
4 -1 -1 -1 8 2 6 9 1
6 2 8 1 -1 -1 3 -1 -1
9 1 7 5 3 -1 8 -1 -1
```

output

```
8 9 2 6 7 4 5 1 3
5 7 1 8 2 3 4 6 9
3 4 6 9 5 1 7 2 8
2 6 4 3 9 7 1 8 5
1 3 5 2 6 8 9 7 4
7 8 9 4 1 5 2 3 6
4 5 3 7 8 2 6 9 1
6 2 8 1 4 9 3 5 7
9 1 7 5 3 6 8 4 2
```

E: 9.9999????

Since some people in BITS started to earn a lot of money, the Supreme Court of BITS decided that whatever income a person gets, the sum of its digits should be equal to k. You wanted to see if the future income of Jignes follows this law. Given the lower bound l and upper bound r of Jignes's salary based on professional estimates, and the digits which Vidyateja found out by breaching his offer letter (he couldn't see all the digits at once); find the number of different possible salaries which Jignes can have (No leading zeros).

Input

The first line contains a four integers n, k, l, r ($1 \leq n \leq 16$; $0 \leq k \leq 144$; $1 \leq l \leq r \leq 10^{15}$).
The second line contains a string of size n. This corresponds to the digits which Vidyateja spotted. "?" denotes that the digit was not spotted, and can take any valid value.
The number of "?"'s is m. ($1 \leq m \leq 7$)

Output

The number of different possible salaries (without any leading zeros) which Jignes can have.

---

input
4 5 2000 10000
????

output
20

---

input
16 1 1 1000000000000000
?000000000000000

output
1

---

input
16 0 1 1000000000000000
???????000000000

output
0

F: Peanut Butter Mayhem

Nom woke up from his deep sleep and decides to build a giant pile of Peanut Butter so he can eat it before and after sleeping without having to move from his place. He goes to a store, which has n distinct types of jars of Peanut Butter available with infinite supply for each type of jar. Each type of jar has a different weight(in kgs). You have to help Nom find the total number of ways he can select the jars, such that the total weight of Peanut Butter that he eats is k kgs.

Note: The order of the jars does not matter.

Input

The first line contains 2 integers n and k ($1 \leq n \leq 20$; $1 \leq k \leq 25$).
The second line contains n distinct weights of jars sold at the store $a_1, a_2, \ldots, a_n$ ($1 \leq a_i \leq 20$).

Output

Find the number of ways in which Nom can select the jars.

```
input
3 9
2 3 5

output
3
```

Explanation: There are 3 different combinations possible :- (2,2,2,3) , (3,3,3) , (2,2,5). There are no other combinations which add up to 9 (Order doesn't matter).

```
input
3 4
1 2 3

output
4
```

```
input
4 10
2 3 5 6

output
5
```

G: And You Thought You Knew LCM...

Monis loves doing multiplication. He loves multiplication so much that he mastered Karatsuba Algorithm too. Now, he decided to multiply strings. He defined string multiplication as $x * a$ where x is a positive integer and a is a string. For example, $5 *$ "ab" = "$ababababab$" or $3 *$ "v" = "vvv".

A string a is divisible by b, if there exists a positive integer x where $b * x = a$. Also, LCM of two strings a and b (defined as $LCM(a, b)$) is the shortest non-empty string that is divisible by both a and b.

Monis gives you two strings a and b and asks you to find $LCM(a, b)$. If LCM does not exist, return -1.

Input

The first line contains a single string a ($1 \leq |a| \leq 10^6$).
The second line contains a single string b ($1 \leq |b| \leq 10^6$).

Output

A single string which is $LCM(a, b)$, if it exists. Otherwise -1.

---

input
ab
abab

output
abab

---

input
ccc
cc

output
cccccc

---

input
abc
d

output
-1

H: The DSA Battle

Nom and Kira competed in a series of competitive problem matches which was streamed all across BITS. They played a series of n matches out of which Kira won a matches and Nom won b matches. Since Nom is less skilled than Kira in DSA, b is **strictly lesser** than a.

You were tired of solving your DSA Assignment, so you slept off and missed the livestream, but you think that the match must've been very close since everyone in your DSA class watched it. So, you imagine a string of length n where the i-th character denotes who won the i-th match - K if Kira, O if Nom. You imagine the string was such that the maximum number of times a player won in a row was as small as possible. For example, in the series of matches KOOKKKO, Kira won 3 times in a row, which is the maximum. You also know that Kira is a greater starter, so he performs very well during the beginning itself.

Since you missed the matches and feel guilty, you decide to find a string satisfying the above conditions. Print the one with maximum Ks to the left. For example, if the answer is KKOK, then any other permutation of the correct answer will not be accepted.

Input

The first line contains 3 integers n, a and b ($3 \leq n \leq 10^5$; $1 \leq b < a \leq n$; $a + b = n$).

Output

A string satisfying the above conditions.

---

input
7 4 3

output
KOKOKOK

---

input
19 13 6

output
KKOKKOKKOKKOKKOKKOK

I: Kira's Greed

Kira was furious that he was not able to help Shimmerun convert the numbers into English. So Kira decided that instead of Billions or something, he now wants to have an m-figure income. In between all this, since the Supreme Court of BITS decided that whatever income a person gets, the sum of its digits should be equal to k, Kira wants to find out his lowest possible (for fun) and highest possible income (The income should not have any leading zeros).

Input

The first line contains 2 integers m and k ($1 \leq m \leq 100$; $0 \leq k \leq 900$) - the number of digits and the sum of digits respectively.

Output

2 integers - lowest possible and highest possible numbers, if they exist. If no such pair exists, print "$-1\ -1$" (without the quotes).

---

input
10 1

output
1000000000 1000000000

---

input
2 15

output
69 96

---

input
3 0

output
-1 -1

J: Why is Vidyateja?

Vidyateja was bored of making websites, so he decided to tamper with your Connect-4 like board. Your board had 3 types of cells:

- an empty cell (.).
- an obstacle (o).
- your coin ($*$).

Due to his antics, the board is now a complete mess. However, the coins are guaranteed to stay in their respective columns, appearing in order from top to bottom, but dispersed. Now, you pick up the board, and all coins fall down until they meet the bottom, an obstacle (an obstacle is immovable always), or another immovable coin.

You have to find the final position of everthing on the board after the falling process (Looking at the samples should make it clear).

Input

The first line contains 2 positive integers n and m ($1 \leq n, m \leq 5000$) - the number of rows and columns in the board.
The consequent n lines contain m characters comprising of an empty cell, an obstacle or a coin.

Output

A grid with n rows and m columns showing the result of the falling process.

---

input

```
6 10
.*.*....*.
.*.......*
...o....o.
.*.*....*.
..........
.o......o*
```

output

```
..........
...*....*.
.*.o....o.
.*........
.*......**
.o.*....o*
```

---

input
2 9
...***ooo
.*o.*o.*o

output
....**ooo
.*o**o.*o

---

input
5 5
*****
*....
*****
....*
*****

output
.....
...
*****
*****
*****