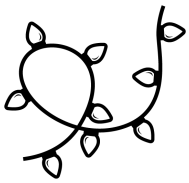
Croatian Open Competition in Informatics

Round 3, December 11th 2021

Tasks

Task	Time limit	Memory limit	Points
Lampice	1 second	512 MiB	50
Cijanobakterije	1 second	512 MiB	70
Akcija	5 seconds	512 MiB	110
Ekoeko	1 second	512 MiB	110
Kućice	1 second	512 MiB	110
Total			450

Task Lampice



Little Vera really likes Advent and Christmas time. Most of all, she likes colorful Christmas lights and enjoys decorating her balcony with shining colors. To decorate her balcony, she bought a sequence of n lights connected in a row, each shining in one of a thousand different colors.

Apart from lights, Vera also really likes repeating patterns, so she would like to have her balcony decorated so that a certain pattern of colors repeats k times in a row. However, the lamps she bought might not satisfy her obsession of repetition and patterns, so she decided to cut off zero or more lamps from the beginning and from the end of the sequence to obtain a sequence in which a pattern of colors repeats k times in a row.

Help her determine whether she can obtain such a sequence of lights by making the mentioned cuts, and if so, print the pattern that will be repeated.

Input

The first line contains positive integers n and k ($1 \leq k \leq n \leq 50$) described above.

The second line contains a sequence of positive integers $a_1, a_2, ..., a_n$ ($1 \leq a_i \leq 1000$) which denotes the colors of the lamps that Vera bought, in the order they appear in her sequence.

Output

If Vera can't cut out a sequence of lights that she wants, print `-1`.

If Vera can cut out a sequence of lights that she wants, in the first line print the length of the repeating pattern, and in the second line print the sequence of colors that makes up the pattern. If there is more than one solution, you can output any one of them.

Scoring

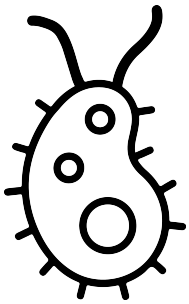
Subtask	Points	Constraints
1	10	The sequence contains a pattern of a single light repeated k times in a row.
2	15	$k = 2$
3	25	No additional constraints.

Examples

input	**input**	**input**
`8 6` `10 1 1 1 1 1 1 5`	`3 2` `1 2 1`	`10 2` `1 5 1 5 2 5 6 2 5 6`
output	**output**	**output**
`1` `1`	`-1`	`2` `1 5`

Clarification of the third example: If Vera cuts off six lights from the end and zero from the beginning, she obtains the sequence of lights `1 5 1 5`, in which the pattern `1 5` repeats twice in a row. If, on the other hand, she cuts off four lights from the beginning and zero from the end, she obtains the sequence of lights `2 5 6 2 5 6`, in which the pattern `2 5 6` repeats twice, so this is also a valid solution.

Task Cijanobakterije



Young microbiologist Maja is making a microscopic Christmas tree out of a species of cyanobacteria called *Stigonema arboreus*. This species is known for its colonies made from individual cells which link together, forming a tree graph. More precisely, for each pair of cyanobacteria in the colony, there is a unique path through the colony from one cyanobacterium to the other.

Maja wants her Christmas tree colony to contain a chain of cyanobacteria that is as long as possible. A chain is determined by a sequence of cyanobacteria, where each cyanobacterium appears at most once, and every pair of adjacent cyanobacteria are directly linked together. Because none of the colonies she currently has is long enough, Maja will have to connect some of the colonies together. She does this by repeatedly choosing two cyanobacteria from different colonies, bringing them close to each other, and joining them with superglue. Since the bacteria are sensitive to cycles, Maja has to be careful not to join two bacteria from the same colony at any time. Using a series of such gluing procedures, Maja wants to obtain a colony which contains the longest possible chain.

Maja is tired from using her microscope, and there a lot of cyanobacteria. Help Maja determine the length of the longest chain of cyanobacteria she could obtain by connecting the colonies. The length of a chain is determined by the number of cyanobacteria from which it is formed.

Input

The first line contains positive integers n and m ($1 \leq n \leq 100\ 000$, $0 \leq m < n$), the number of cyanobacteria and the number of direct connections between them.

The following m lines contain a pair of positive integers a_i, b_i ($1 \leq a_i, b_i \leq n$) which denote that the bacteria a_i and b_i are directly linked. No bacterium is directly linked to itself, and no connection will be listed more than once.

The connections are such that the bacteria form some colonies, each of which is a tree.

Output

In the only line print the largest possible length of a chain in the final colony.

Scoring

Subtask	Points	Constraints
1	15	$m = n - 1$
2	6	$b_i = a_i + 1$ for each $i = 1, \ldots, m$
3	6	$1 \leq a_i \leq 2$ for each $i = 1, \ldots, m$
4	15	$1 \leq n \leq 1000$
5	28	No additional constrains.

Examples

input

```
100 0
```

output

```
100
```

input

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

output

```
6
```

input

```
6 5
1 2
2 3
3 4
4 6
4 5
```

output

```
5
```

Clarification of the second example:
In the second example there are two colonies of cyanobacteria. In the first colony, all cyanobacteria are directly connected to cyanobacterium 1, and in the second with cyanobacterium 5. If any two cyanobacteria except 1 and except 5 are connected, the resulting colony will contain the longest possible chain. Eg. if 2 and 6 are connected, one such chain will be 3 - 1 - 2 - 6 - 5 - 7 which has length 6.

Task Akcija

Christmas, a time for giving. Mr. Malnar is in need of gift ideas. Although deep in thought, the television program grabs his attention: "Special offer! This amazing product is on sale for just w kunas. Call now because the offer is available only if you call within the next d minutes. But that's not all..."

There are n different products on sale, where the i-th product has a cost of w_i, and it's available for order until the minute d_i (inclusive). Making a call to place an order requires one minute. A subset of products is called *obtainable* if it is possible to make a sequence of calls which order those products while meeting the mentioned deadlines. No product can be ordered more than once.

Mr. Malnar intends to buy as many products as possible, at the least possible price, but he's not yet sure which products he should buy. He compares two obtainable subsets in the following way: the better obtainable subset is the one with more products, and if they have equal size, it's the one that has a smaller total cost (sum of costs of chosen products).

Mr. Malnar will rank the obtainable subsets in the described manner and he will take into consideration k of the best ones. Write a program which determines the size and the total cost for k of the best obtainable subsets.

Input

The first line contains positive integers n and k - the number of different products and the number of obtainable subsets to be taken into consideration, respectively. k will be less than or equal to the total number of obtainable subsets.

The following n lines contain two positive integers w_i ($1 \leq w_i \leq 10^9$) and d_i ($1 \leq d_i \leq n$) - the cost of the i-th product and the last minute for which the offers stands, respectively.

Output

In the i-th line print the size and the total cost of the i-th best obtainable subset.

Scoring

In every subtask, it holds that $1 \leq n, k \leq 2000$.

Subtask	Points	Constraints
1	10	$k = 1$, $w_1 = ... = w_n$
2	20	$k = 1$
3	20	$k = 2$
4	10	$1 \leq n \leq 20$
5	30	$1 \leq n, k \leq 100$
6	20	No additional constraints.

Examples

input

```
3 1
1 1
1 1
1 3
```

output

```
2 2
```

input

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

output

```
3 13
3 22
2 3
```

input

```
2 4
1 1
2 2
```

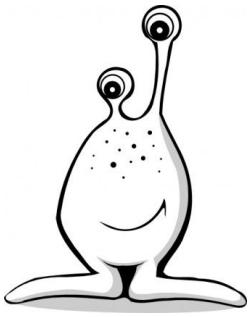
output

```
2 3
1 1
1 2
0 0
```

Clarification of the second example:

Products 1 and 2 can't simultaneously be in an obtainable subset, so the three best obtainable subsets are $\{1, 3, 4\}$, $\{2, 3, 4\}$ i $\{1, 3\}$.

Task Ekoeko



You must be familiar with the story of an alien called Eko Eko, who got his name due to a malfunction in his translation device. The little alien is once again back on Earth to help earthlings with a clean-up after the Advent. However, Eko Eko's translation device has stopped working again.

This time, not only does the device repeat a word, but it also changes the order of the letters in a word. For example, the word "`slon`" first becomes "`slonslon`", and then by changing the order of the letters it could become "`slosnoln`" or "`soolnlsn`" etc. The amount of gold needed to repair Eoo Kek's device depends on the number of swaps of adjacent characters needed to make Kok Oee's badly translated word into a word which is made from just repetition.

For example, if Keo Koe's device translates a word to "`soolnlsn`", it is sufficient to make four swaps of adjacent characters to obtain a word which is made from a repetition - "`olsnolsn`" (see the clarification of the third example), so four pieces of gold are enough to repair his device. Notice that the word obtained from a sequence of such swaps is not necessarily the word that Koo Kee originally wanted to say. This does not effect the amount of gold needed to repair his device.

You would like to help Eke Koo, but if you steal a large amount of jewelry from your mother you won't get a Christmas present. That's why for a given word that came out of Keo Koe's translation device, you want to determine the least possible number of swaps of adjacent characters to get a word which is made from just repetition.

Input

The first line contains a positive integer n - the length of the word that Eek Ook is trying to say.

The second line contains a sequence of $2n$ characters, each being a lowercase letter of the Latin alphabet, representing the word that came out of Eok Eok's translation device. Each letter will appear an even number of times.

Output

In the only line print the least possible number of swaps of adjacent characters to make Keo Koe's word into a single-repetition word.

Scoring

Constraints on n are $1 \leq n \leq 100\,000$ in all subtasks.

Subtask	Points	Constraints
1	10	The string consists of n occurrences of `a`, and then n of `b`.
2	20	Each letter appears at most twice.
3	20	The first n and the last n letters are the same, but possibly in a different order.
4	20	$1 \leq n \leq 1000$
5	40	No additional constraints.

Examples

input	input	input
3 koeeok	3 kekoeo	4 soolnlsn
output	**output**	**output**
3	1	4

Clarification of the third example:
One way to get from `soolnlsn` to a single-repetition word using four swaps is

$$\texttt{soolnlsn} \to \texttt{so}\underline{\texttt{lo}}\texttt{nlsn} \to \texttt{sol}\underline{\texttt{no}}\texttt{lsn} \to \underline{\texttt{os}}\texttt{lnolsn} \to \texttt{o}\underline{\texttt{ls}}\texttt{nolsn}$$

Task Kućice

Everyone knows that every other booth at the Zagreb Christmas Market was actually set up just by pulling the right strings. This year the authorities have decided to send an inspection to penalize the booths that were set up illegitimately.

There are n booths, which can be represented by points in the plane, where no three of them lie on the same line. The authorities will identify the booths ruled by corruption and fence them off from the rest of the town. The fence will surround the mentioned booths and it will form the shape of the smallest convex polygon containing all of them. In other words, the fence can be thought of as the boundary of the convex hull of the chosen set of points. Unfortunately, it's possible that some of the innocent booths become fenced off as well.

Before an on-site inspection, the authorities estimate that the probability of corruption of any particular booth is 50%. Having this in mind, they wonder what is the expected number of booths which will end up being fenced off. The expected value is defined by multiplying the probability of a certain subset of booths being chosen by the number of booths fenced off in that choice, and summing this up for all possible choices of the subset. Of course, if the chosen subset consists of less than three points, the convex hull is degenerate, i.e. a segment, point or the empty set.

It can be proven that the desired expected value can be written in the form $\frac{m}{2^n}$, for some positive integer m. The authorities would like to know the expected value, so they kindly ask you to compute the value of m. Since the answer can be very large, you should print it modulo $10^9 + 7$.

Input

The first line contains a positive integer n ($1 \leq n \leq 1000$), the number of booths.

The i-th of the next n lines contains a pair of positive integers x_i, y_i ($|x_i|, |y_i| \leq 10^6$), which represent the x and y coordinates of the i-th booth, respectively. No two booths have the same location.

No three booths will lie on the same line.

Output

In the only line print the number m described above, modulo $10^9 + 7$.

Scoring

Subtask	Points	Constraints
1	10	All points are on the boundary of the convex hull of all points and $n \geq 3$.
2	30	All points except the first one are on the boundary of the convex hull of all points, which is is the interior, and $n \geq 4$, $x_1 = y_1 = 0$.
3	10	$1 \leq n \leq 15$
4	30	$1 \leq n \leq 100$
5	30	No additional constraints.

Examples

input	input	input
1 5 5	3 -1 -1 1 -1 0 1	5 0 0 -1 0 2 -1 3 2 0 3
output	**output**	**output**
1	12	83

Clarification of the first example:
There is a probability of 50% that the first and only booth gets fenced off, so the expected value is $\frac{1}{2}$.

Clarification of the second example:
There are eight possible choices for a subset, and the number of fenced off booths for those choices is $0, 1, 1, 1, 2, 2, 2, 3$. The expected value is then $\frac{1}{8}(0+1+1+1+2+2+2+3) = \frac{12}{8}$.