Task Overview Sheet

	Type Printer	Islands	Fish
Type	Batch (stdin/stdout)*	Batch (stdin/stdout)*	Batch (stdin/stdout)*
Time Limit (per test case)	1 second	2 seconds	3 seconds
Memory Limit (per test case)	64 MB	128 MB	64 MB
Points	100	100	100

* C++ programmers should be aware that usage of C++ streams (cin/cout) may lead to I/O bottlenecks. We highly recommend usage of scanf/printf instead.

TYPE PRINTER

You need to print ***N*** words on a movable type printer. Movable type printers are those old printers that require you to place small metal pieces (each containing a letter) in order to form words. A piece of paper is then pressed against them to print the word. The printer you have allows you to do any of the following operations:

- Add a letter to the end of the word currently in the printer.
- Remove the last letter from the end of the word currently in the printer. You are only allowed to do this if there is at least one letter currently in the printer.
- Print the word currently in the printer.

Initially, the printer is empty; it contains no metal pieces with letters. At the end of printing, you are allowed to leave some letters in the printer. Also, you are allowed to print the words in any order you like.

As every operation requires time, you want to minimize the total number of operations.

TASK

You must write a program that, given the ***N*** words you want to print, finds the minimum number of operations needed to print all the words in any order, and outputs one such sequence of operations.

CONSTRAINTS

1 <= ***N*** <= 25,000 The number of words you need to print.

INPUT

Your program must read from the standard input the following data:

- Line 1 contains the integer ***N***, the number of words you need to print.
- Each of the next ***N*** lines contains a word. Each word consists of lower case letters ('a' – 'z') only and has length between 1 and 20, inclusive.
  All words will be distinct.

OUTPUT

Your program must write to the standard output the following data:

- Line 1 must contain an integer ***M*** that represents the minimum number of operations required to print the ***N*** words.
- Each of the next ***M*** lines must contain one character each. These characters describe the sequence of operations done. Each operation must be described as follows:
  - Adding a letter is represented by the letter itself in lowercase
  - Removing the last letter is represented by the character '-' (minus, ASCII code 45)

- Printing the current word is represented by the character 'P' (uppercase letter P)

GRADING

For a number of tests, worth a total of 40 points, N will not exceed 18.

DETAILED FEEDBACK

During the contest, your submissions for this task will be evaluated on some of the official test data, showing you a summary of the results.

EXAMPLE

Sample input	Sample output
3 print the poem	20 t h e P - - - p o e m P - - - r i n t P

FISH

It was told by Scheherazade that far away, in the middle of the desert, there is a lake. Originally this lake had ***F*** fish in it. ***K*** different kinds of gemstones were chosen among the most valuable on Earth, and to each of the ***F*** fish exactly one gem was given for it to swallow. Note, that since ***K*** might be less than ***F***, two or more fish might swallow gems of the same kind.

As time went by, some fish ate some of the other fish. One fish can eat another if and only if it is at least twice as long (fish ***A*** can eat fish ***B*** if and only if $L_A >= 2 * L_B$). There is no rule as to when a fish decides to eat. One fish might decide to eat several smaller fish one after another, while some fish may decide not to eat any fish, even if they can. When a fish eats a smaller one, its length doesn't change, but the gems in the stomach of the smaller fish end up undamaged in the stomach of the larger fish.

Scheherazade has said that if you are able to find the lake, you will be allowed to take out one fish and keep all the gems in its stomach for yourself. You are willing to try your luck, but before you head out on the long journey, you want to know how many different combinations of gems you could obtain by catching a single fish.

TASK

Write a program that given the length of each fish and the kind of gemstone originally swallowed by each fish, finds **the number of different combinations of gems that can end up in the stomach of any fish, modulo some given integer *M*.** A combination is defined only by the number of gems from each of the ***K*** kinds. There is no notion of order between gems, and any two gems of the same kind are indistinguishable.

CONSTRAINTS

1 <= ***F*** <= 500,000	The original number of fish in the lake.
1 <= ***K*** <= ***F***	The number of different gemstone kinds.
2 <=***M*** <= 30,000	
1 <= L_X <= 1,000,000,000	The length of fish *X*.

INPUT

Your program must read from the standard input the following data:

- Line 1 contains the integer ***F***, the original number of fish in the lake.
- Line 2 contains the integer ***K***, the number of kinds of gemstones.

The kinds of gemstones are represented by integers 1 to ***K***, inclusive.

- Line 3 contains the integer ***M***.
- Each of the following ***F*** lines describes one fish using 2 integers separated by a single space: the length of the fish followed by the kind of gemstone originally swallowed by that fish.

NOTE: For all test cases used for evaluation, it is guaranteed that there is at least one gemstone from each of the ***K*** kinds.

OUTPUT

Your program must write to the standard output a single line containing one integer between 0 and ***M-1*** (inclusive): the number of different possible combinations of gemstones **modulo *M***.
Note that for solving the task, the value of ***M*** has no importance other than simplifying computations.

GRADING

For a number of tests, worth a total of 70 points, ***K*** will not exceed 7,000.
Also, for some of these tests, worth a total of 25 points, ***K*** will not exceed 20.

DETAILED FEEDBACK

During the contest, your submissions for this task will be evaluated on some of the official test data showing you a summary of the results.

EXAMPLE

Sample Input	Sample Output
5 3 7 2 2 5 1 8 3 4 1 2 3	4

There are 11 possible combinations so you should output 11 modulo 7 which is 4.

The possible combinations are: [1] [1,2] [1,2,3] [1,2,3,3] [1,3] [1,3,3] [2] [2,3] [2,3,3] [3] and [3,3].
(For each combination, we list the gems it contains. For example, [2,3,3] is a combination that consists of one gem of kind 2, and two gems of kind 3.)
These combinations can be achieved in the following ways:

- [1]: It is possible that you catch the second (or the fourth) fish before it eats any other fish.
- [1,2]: If the second fish eats the first fish, then it would have a gemstone of kind 1 (the one it originally swallowed) and a gemstone of kind 2 (from the stomach of the first fish).
- [1,2,3]: One possible way of reaching this combination: the fourth fish eats the first fish, and then the third fish eats the fourth fish. If you now catch the third fish, it will have one gemstone of each kind in its stomach.
- [1,2,3,3]: Fourth eats first, third eats fourth, third eats fifth, you catch the third one.
- [1,3]: Third eats fourth, you catch it.

- [1,3,3]: Third eats fifth, third eats fourth, you catch it.
- [2]: You catch the first fish.
- [2,3]: Third eats first, you catch it.
- [2,3,3]: Third eats first, third eats fifth, you catch it.
- [3]: You catch the third fish.
- [3,3]: Third eats fifth, you catch it.

Islands

You are visiting a park which has ***N*** islands. From each island ***i***, exactly one bridge was constructed. The length of that bridge is denoted by L_i. The total number of bridges in the park is ***N***. Although each bridge was built from one island to another, now every bridge can be traversed in both directions. Also, for each pair of islands, there is a unique ferry that travels back and forth between them.

Since you like walking better than riding ferries, you want to maximize the sum of the lengths of the bridges you cross, subject to the constraints below.

- You can start your visit at an island of your choice.
- You may not visit any island more than once.
- At any time you may move from your current island ***S*** to another island ***D*** that you have **not** visited before. You can go from ***S*** to ***D*** either by:
  - Walking: Only possible if there is a bridge between the two islands. With this option the length of the bridge is added to the total distance you have walked, or
  - Ferry: You can choose this option only if ***D*** is not reachable from ***S*** using any combination of bridges and/or previously used ferries. (When checking whether it is reachable or not, you consider all paths, including paths passing through islands that you have already visited.)

Note that you do not have to visit all the islands, and it may be impossible to cross all the bridges.

TASK

Write a program that, given the ***N*** bridges along with their lengths, computes the maximum distance you can walk over the bridges obeying the rules described above.

CONSTRAINTS

$2 <= N <= 1{,}000{,}000$	The number of islands in the park.
$1 <= L_i <= 100{,}000{,}000$	The length of bridge ***i***.

INPUT

Your program must read from the standard input the following data:

- Line 1 contains the integer ***N***, the number of islands in the park. Islands are numbered from 1 to ***N***, inclusive.
- Each of the next ***N*** lines describes a bridge. The i^{th} of these lines describes the bridge constructed from island ***i*** using two integers separated by a single space. The first integer represents the island at the other endpoint of the bridge, the second integer represents the length L_i of the bridge. You may assume that for each bridge, its endpoints are always on two different islands.

OUTPUT

Your program must write to the standard output a single line containing one integer, the maximum possible walking distance.

NOTE 1: For some of the test cases the answer will not fit in a 32-bit integer, you might need int64 in Pascal or long long in C/C++ to score full points on this problem.

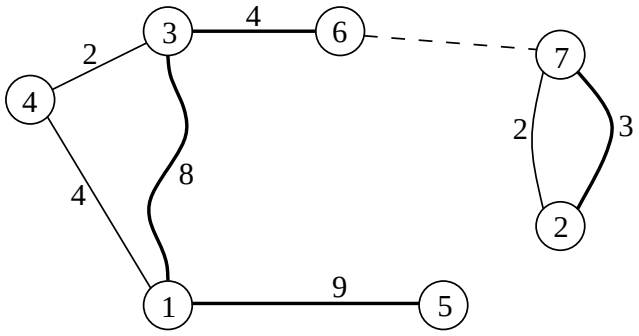
NOTE 2: When running Pascal programs in the contest environment, it is significantly slower to read in 64-bit data types than 32-bit data types from standard input even when the values being read in fit in 32 bits. We recommend that you read the input data into 32-bit data types.

GRADING

For some cases worth 40 points, ***N*** will not exceed 4,000.

EXAMPLE

Sample input	Sample output
7 3 8 7 2 4 2 1 4 1 9 3 4 2 3	24



The ***N=7*** bridges in the sample are (1-3), (2-7), (3-4), (4-1), (5-1), (6-3) and (7-2). Note that there are two different bridges connecting islands 2 and 7.

One way how you can achieve maximum walking distance follows:

- Start on island 5.
- Walk the bridge of length 9 to reach island 1.
- Walk the bridge of length 8 to reach island 3.
- Walk the bridge of length 4 to reach island 6.
- Take the ferry from island 6 to island 7.
- Walk the bridge of length 3 to reach island 2.

By the end you are on island 2 and your total walking distance is 9+8+4+3 = 24.

The only island that was not visited is island 4. Note that at the end of the trip described above you can not visit this island any more. More precisely:

- You are not able to visit it by walking, because there is no bridge connecting island 2 (where you currently stand) and island 4.
- You are not able to visit it using a ferry, because island 4 is reachable from island 2, where you currently stand. A way to reach it: use the bridge (2-7), then use a ferry you already used to get from island 7 to island 6, then the bridge (6-3), and finally the bridge (3-4).