2014 Mid-Atlantic Regional Programming Contest

Welcome to the 2014 ICPC Mid-Atlantic Regional. Before you start the contest, please take the time to review the following:

The Contest

1. There are eight (8) problems in the packet, labeled A–H. These problems are NOT sorted by difficulty. As a team's solution is judged correct, the team will be awarded a balloon. The balloon colors are as follows:

Problem	Problem Name	Balloon Color
A	Hy-phe-na-tion Rulez	Orange
B	A Stable Relationship	Green
C	All Things Being Equal	Silver
D	Everything in Excess!	Pink
E	Not Sew Difficult	Red
F	Tight Knight	Yellow
G	Stealth	Purple
H	Verti-Words	Black

2. Solutions for problems submitted for judging are called runs. Each run will be judged.

   The judges will respond to your submission with one of the following responses. In the event that more than one response is applicable, the judges may respond with any of the applicable responses.

Response	Explanation
Yes	Your submission has been judged correct.
Wrong Answer	Your submission generated output that is not correct.
Output Format Error	Your submission's output is not in the correct format or is misspelled.
Incomplete Output	Your submission did not produce all of the required output.
Excessive Output	Your submission generated output in addition to or instead of what is required.
Compilation Error	Your submission failed to compile.
Run-Time Error	Your submission experienced a run-time error.
Time-Limit Exceeded	Your submission did not solve the judges' test data within 30 seconds.
Other-Contact Staff	Contact your local site judge for clarification.

3. A team's score is based on the number of problems they solve and penalty points, which reflect the amount of time and number of incorrect submissions made before the problem is

solved. For each problem solved correctly, penalty points are charged equal to the time at which the problem was solved plus 20 minutes for each incorrect submission. No penalty points are added for problems that are never solved. Teams are ranked first by the number of problems solved and then by the fewest penalty points.

4. This problem set contains sample input and output for each problem. However, the judges will test your submission against longer and more complex datasets, which will not be revealed until after the contest. Your major challenge is designing other input sets for yourself so that you may fully test your program before submitting your run. Should you receive a judgment stating that your submission was incorrect, you should consider what other datasets you could design to further evaluate your program.

5. In the event that you feel a problem statement is ambiguous or incorrect, you may request a clarification. Read the problem carefully before requesting a clarification.

   If a clarification is issued during the contest, it will be broadcast to *all* teams.

   If the judges believe that the problem statement is sufficiently clear, you will receive the response, "No response, read problem statement." If you receive this response, you should read the problem description more carefully. If you still feel there is an ambiguity, you will have to be more specific or descriptive of the ambiguity you may have found.

   - You may **not** submit clarification requests asking for the correct output for inputs that you provide, e.g.,

     What would the correct output be for the input ...?

     Determining that is your job unless the problem description is truly ambiguous.

   - Sample inputs *may* be useful in explaining the nature of a perceived ambiguity, e.g.,

     There is no statement about the desired order of outputs. Given the input: ..., would both this: ... and this: ... be valid outputs?

6. Runs for each particular problem will be judged in the order they are received. However, it is possible that runs for different problems may be judged out of order. For example, you may submit a run for problem B followed by a run for problem C, but receive the response for C first.

   Do not request clarifications on when a response will be returned. If you have not received a response for a run within 30 minutes of submitting it, **you may have a runner ask the local site judge to determine the cause of the delay.** Under no circumstances should you ever submit a clarification request about a submission for which you have not received a judgment.

   If, due to unforeseen circumstances, judging for one or more problems begins to lag more than 30 minutes behind submissions, a clarification announcement will be issued to all teams. This announcement will include a change to the 30 minute time period that teams are expected to wait before consulting the site judge.

7. The submission of abusive programs or clarification requests to the judges will be considered grounds for immediate disqualification.

8. The submission of code deliberately designed to delay, crash, or otherwise negatively affect the contest itself will be considered grounds for immediate disqualification.

Your Programs

9. All solutions must read from standard input and write to standard output. In C this is `scanf`/`printf`, in C++ this is `cin`/`cout`, and in Java this is `System.in`/`System.out`. The judges will ignore all output sent to standard error (`stderr` in C, `cerr` in C++, or `System.err` in Java). You may wish to use standard error to output debugging information. From your workstation you may test your program with an input file by redirecting input from a file:

   ```
   program < file.in
   ```

10. Unless otherwise specified, all lines of program output

    - must be left justified, with no leading blank spaces prior to the first non-blank character on that line,
    - must end with the appropriate line terminator (`\n`, `endl`, or `println()`), and
    - must not contain any blank characters at the end of the line, between the final specified output and the line terminator.

    You must not print extra lines of output, even if empty, that are not specifically required by the problem statement.

11. Unless otherwise specified, all numbers in your output should begin with the minus sign (−) if negative, followed immediately by 1 or more decimal digits. If the number being printed is a floating point number, then the decimal point should appear, followed by the appropriate number of decimal digits. For output of real numbers, the number of digits after the decimal point will be specified in the problem description (as the "precision").

    All floating point numbers printed to a given precision should be rounded to the nearest value. For example, if 2 decimal digits of precision is requested, then 0.0152 would be printed as "0.02" but 0.0149 would be printed as "0.01".

    In other words, neither scientific notation nor commas will be used for numbers, and you should ensure that you use a printing technique that rounds to the appropriate precision.

12. All input sets used by the judges will follow the input format specification found in the problem description. You do not need to test for input that violates the input format specified in the problem.

13. All lines of program input will end with the appropriate line terminator (e.g., a linefeed on Unix/Linux systems, a carriage return-linefeed pair on Windows systems).

14. If a problem specifies that an input is a floating point number, the input will be presented according to the rules stipulated above for output of real numbers, except that decimal points and the following digits may be omitted for numbers with no non-zero decimal portion. Scientific notation will not be used in input sets unless a problem explicitly allows it.

15. Every effort has been made to ensure that the compilers and run-time environments used by the judges are as similar as possible to those that you will use in developing your code. With that said, some differences may exist. It is, in general, your responsibility to write your code in a portable manner compliant with the rules and standards of the programming language. You should not rely upon undocumented and non-standard behaviors.

    (a) One place where differences are likely to arise is in the size of the various numeric types. Many problems will specify minimum and maximum values for numeric inputs and outputs. You should write your code with the understanding that, on the *judges'* machines:

    - A C++ `int`, a C++ `long`, and a Java `int` are all 32-bits wide.
    - A C++ `long long` and a Java `long` are 64-bits wide.
    - A `float` in both languages is a 32-bit value capable of holding 6-7 decimal digits, though many library functions will be less accurate.
    - A `double` in both languages is a 64-bit value capable of holding 15-16 decimal digits, though many library functions will be less accurate.

    The data types on your own machines may differ in size from these, but if you follow the guidelines above in choosing the types to hold your numbers, you can be assured that they will suffice to hold those values on the judges' machines.

    (b) Another common source of non-portability is in C/C++ library structures. Although the C & C++ standards are very explicit about which header files must declare certain `std` symbols, the standards do not prohibit other headers from duplicating or loading extra symbols.

    For example, if your program uses both `cout` and `ifstream`, you might find that your code compiles if you only `#include <fstream>`, because, as it happens, on *your* machine the `fstream` header `#include`s the `iostream` header where `cout` is properly declared. However, you cannot rely upon the judges' machines having libraries with the same structure. So it is *your* responsibility to `#include` the appropriate headers for whatever `std` library features you use.

Good luck, and HAVE FUN!!!

Problem A: Hy-phe-na-tion Rulez

Word processors often split a word across lines using hyphenation, a technique requiring some knowledge of where the syllables in the word are divided. Generally, the word processor knows a handful of basic rules for dividing words into syllables, and then keeps a dictionary of known exceptional cases.

Write a program that accepts a list of words (consecutive string of non-whitespace characters) as input and prints each word, one per line, with hyphens inserted at each possible hyphenation point as defined by the following rules:

1. If you see the pattern *vowel-consonant-consonant-vowel*, hyphenate between the two consonants. (For the purpose of this program, the vowels are ‘a’, ‘e’, ‘i’, ‘o’, ‘u’, and ‘y’. ‘y’ will always be treated as a vowel.)

2. If you see the pattern *vowel-consonant-vowel*, hyphenate before the consonant unless the second vowel is an ‘e’ and occurs at the end of the word.

3. The following character sequences are never divided by hyphens:

   “qu”, “tr”, “br”, “str”, “st”, “sl”, “bl”, “cr”, “ph”, “ch”.

   For the purpose of applying rules 1 and 2, these are all considered to be a single consonant.

4. Upper and lower-case distinctions are ignored for the purpose of applying the above rules, although the case in the input word must be preserved in the output.

Input

Input will consist of a single data set terminated by a line containing only “===” (three equal signs).

The data set consists of multiple lines of text, each line containing $0 \ldots 80$ characters (not including the line terminator).

Output

Each word from the input is to be printed on a single line, with hyphens inserted at all valid hyphenation points.

Example

Input:

Given the input

```
Word processors often split a word across lines using hyphenation,
a technique requiring some knowledge of where the syllables in
the word are divided.

The rules given in this problem are a bit crude. But they represent a
good starting point.
===
```

the output would be

Output:

```
Word
pro-ces-sors
of-ten
split
a
word
a-cross
li-nes
u-sing
hy-phe-na-tion,
a
tech-nique
re-qui-ring
some
know-led-ge
of
where
the
syl-la-bles
in
the
word
are
di-vi-ded.
The
ru-les
gi-ven
in
this
pro-blem
are
a
```

```
bit
cru-de.
But
they
rep-re-sent
a
good
star-ting
point.
```

Problem B: A Stable Relationship

You recently bought a 3D printer. Using the 3D printer has been a lot of fun, but, from time to time, your attempt to print an object is spoiled because the object topples while being printed.

An object is printed by depositing layers of material from bottom to top. We will assume that the layers are formed of identically-sized cubes of the printing material, each of which occupies a cell in a 3D grid. All cubes are made of the same material and therefore weigh the same. We will also assume that the forces exerted by the 3D printer on the object during printing are negligible.

Whether the object will topple will be determined only by the location of the center of mass of the partially printed object relative to the base layer of the object. Specifically, let P be the horizontal plane on which the bottom or base layer of the object lies. Let C be the projection on P of the partially- or wholly-printed object's center of mass. The object will not topple if and only if there exists a triangle strictly containing C, with each of the three vertices lying under one of the printed blocks of the bottom layer. (The vertices may lie under any combination of 1, 2, or 3 such blocks.)

The material in each layer is printed such that, if the object will not topple after the whole layer is deposited, it will not topple at any time during printing that layer. Moreover, we will assume that the printed object will always be in a single piece throughout the printing process and that there is at least one block printed on the base layer.

Given the 3D object to be printed, determine whether the object will topple during printing.

Input

The input will consist of one or more test cases.

Each test case starts with 3 positive integers, each less than or equal to 200: The width (w) , length (l), and height (h) of the object. End of input is signalled by a line containing 3 zeroes.

After a line containing positive w, l, and h, the input contains h blocks representing the layers of the object from bottom to top. Each block has l lines of w characters each.

The characters used on each line are '.', representing an empty grid cell, and/or '#', representing a grid cell where material will be deposited.

Output

For each test case, print exactly one line with either Will topple or Will not topple. If the object will topple during printing or after printing is complete, print Will topple. Otherwise, print Will not topple.

Example

Input:

Given the input

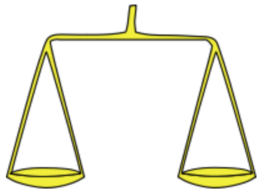
```
3 3 2
###
.#.
#.#
...
.#.
...
3 1 3
..#
.##
###
0 0 0
```

the output would be

Output:

```
Will not topple
Will topple
```

Problem C: All Things Being Equal



A pan balance consists of a horizontal arm, able to pivot around its center, with a light pan hanging from each end on which items of various weights can be placed. When the weights in the pans on each side are equal, the arm stays horizontal. If the weights on each side are unequal, the arm dips down on the heavier side.

A bored apothecary who received a mistaken shipment of several hundred pan balances began to rearrange them so that some of the pans were replaced by strings from which hung other pan balances. in a fashion similar to a mobile but restricted to having each bar pivoting about its center. He placed weights in the remaining pans sufficient to guarantee that each bar was balanced.

The pans and connecting bars are made from a lightweight material. Each pan and each bar weighs one gram. The weight of the strings may be ignored.

Adding to this construction day by day, he eventually had a rather impressive construction that he was pleased to display in his store. Periodically, he would disassemble it for cleaning or to move it to another location, but he had kept detailed notes on the weights in each pan to make reconstruction easy.

All was well until, one day, someone spilled coffee on his notes, leaving him unable to read the weight values recorded for several pans.

Given the remaining partial description of the construction, determine what weights, in grams, need to be placed in the pans whose notes were obscured in order to restore the balance.

Input

Input will consist of one or more test cases.

Each test case will consist of a description of the top balance arm.

A balance arm is described by an expression consisting of a left square bracket “[” followed by an expression x, followed by an expression y, followed by a right square bracket “]”, where x and y can each be replaced by any of:

- an integer indicating the number of grams of weight in a pan, or
- a single upper-case alphabetic character, indicating a pan whose associated weight is unknown, or
- another balance arm expression indicating a pan balance suspended from one end of this bar in lieu of a pan.

Some alphabetic characters may be repeated in two or more positions, indicating that the apothecary’s notes imply indicated that one pan contained the same weight as another, whose exact value is unknown.

No more than 50 balance arms will be used in any input case.

End of input will be indicated by a line containing the character sequence “[]”.

Output

If there is a unique valid solution to the problem of adding weights to the empty pans to restore balance, then print, for each alphabetic symbol used for an empty pan, a line consisting of the alphabetic symbol identifying that pan, a single blank, and then the number of grams to be placed in that pan.

These lines should appear in ascending order of the alphabetic identifiers. The gram weights should be printed as a floating point number to two decimal places of precision. A valid solution will involve only non-negative values for the weights.

If there is no valid solution that would restore balance, print a line consisting of the word “NONE”.

If there are multiple valid solutions that would restore balance, print a line consisting of the word “MANY”.

Example

Input:

Given the input

```
[ [A B] 5]
[ Z
  [A [ 2 3 ] ]
]
[]
```

the output would be

Output:

```
A 1.50
B 1.50
NONE
```

Problem D: Everything in Excess!

The prime factorization of a positive integer n is the list of n's prime factors, together with their multiplicities:

$$n = \prod_{i=1}^{k} p_i^{m_i}$$

where the p_i are the factors (prime numbers) and the m_i are the corresponding multiplicities.

The *excess* of n is defined as the sum of the multiplicities ($\sum_{i=1}^{k} m_i$) minus the number of factors (k). It describes the number of times that factors get "re-used" in the factorization. For example, the excess of 8 is 2, the excess of 16 is 3, and the excess of 100 is 2.

Given a pair of integers $n_0 \leq n_1$, print the integer n that has the largest excess of any integer in the range $n_0 \ldots n_1$ (inclusive).

Input

The input will consist of one or more test cases.

Each test case will be presented on a single line as a pair of integers, in the range $2 \ldots 10{,}000{,}000$, denoting the values n_0 and n_1 as described above.

End of input will be indicated by a line containing "0 0".

Output

For each test case, print a single integer indicating the value in the range $n_0 \ldots n_1$ with the largest excess. If two or more values in the range tie for the largest excess, print the lowest such value.

Example

Input:

Given the input

```
2 11
600 700
0 0
```

the output would be

Output:

```
8
640
```

Problem E: Not Sew Difficult

A quilt will be made by laying a number of rectangular pieces of fabric onto a square cloth backing. The rectangular pieces will all be laid with one edge parallel to an edge of the cloth backing.

We plan to sew the overlapping pieces together, and need to know the maximum thickness of fabric (not counting the backing) that we will need to push a needle through at any point.

The rectangles will be positioned at non-negative integer coordinates on a $100,000$ by $100,000$ grid with axes defined by the cloth backing and one corner of the backing treated as the origin. All rectangular pieces will lie entirely within the bounds of the backing cloth.

Pieces overlap only if they do so along a non-zero area. Pieces that are simply adjacent along an edge or at a corner point are not considered overlapping.

Input

The input will consist of one or more test cases.

Each test case begins with a line containing an integer N, $1 \leq N \leq 1000$, denoting the number of rectangles. (End of input is signalled by a non-positive value for N.)

This is followed by N lines, each containing four non-negative integers x_1 y_1 x_2 y_2, defining the coordinates of two opposite corners of a rectangle.

Output

For each dataset, print a single line containing an integer D, denoting the maximum depth of overlapping pieces of fabric.

Example

Input:

Given the input

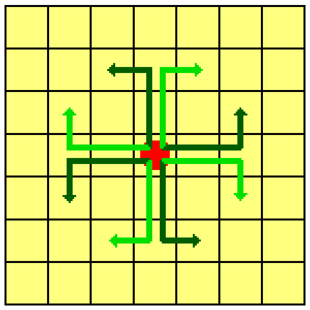
```
4
0 0 10 10
1 1 9 9
4 4 10 10
3 3 5 6
3
100 100 200 200
50 60 200 350
150 250 160 260
-1
```

the output would be

Output:

```
4
2
```

Problem F: Tight Knight



A knight in chess can move from its current position on a chessboard to any empty square that is either

- two steps vertically and one step horizontally, or
- one step vertically and two steps horizontally

away from its current position. Thus a knight positioned in the middle of an otherwise empty board could move to any of eight different locations, as shown in the accompanying diagram.

The empty/occupied status of any intermediate squares is irrelevant. A knight can only be blocked by an obstacle on the actual destination square.

Consider an n x m chessboard, $1 \leq n \leq 1000$, $1 \leq m \leq 1000$. A knight has been placed on square (i, j) of the board, where the rows and columns are numbered beginning at 1, so that $1 \leq i \leq n$, $1 \leq j \leq m$. There are c obstacles on squares of the board, $0 \leq c \leq 5000$. The knight cannot move to the squares with obstacles.

Can we prevent the knight from reaching another square (k, l), $1 \leq k \leq n$, $1 \leq l \leq m$, by adding at most one obstacle?

Input

Input may include multiple test cases.

Each test case starts with seven integers on a single line separated by spaces: n, m, i, j, k, l, c. End of input is signalled by a line containing seven integers with n being zero.

Following that first line of the test case are c lines, each with two integers x, y, specifying the location (x, y) of each of the obstacles. $1 \leq x \leq n$, $1 \leq y \leq m$. No obstacle will be placed at (i, j) or (k, l).

Output

For each test case, print exactly one line of output. If the knight cannot reach cell (k, l) or can be prevented from reaching cell (k, l) by adding at most one obstacle (at a location other than (i, j) or (k, l)), print 'Yes'. If not, print 'No'.

Example

Input:

Given the input

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

```
4 1
4 4 1 1 4 4 2
1 4
3 2
0 0 0 0 0 0 0
```

the output would be

Output:

```
No
Yes
```

Problem G: Stealth

A submersible robot is designed to walk, crab-like, across the ocean floor. It is presented with a rectangular area measuring w by h (integers, measured in meters) that it must cross, starting from $x = 0$ and ending at $x = w$.

$$1 \leq w \leq 100, 1 \leq h \leq 100$$

A series of N sonar probes, $0 < N \leq 40$ are suspended above the course, at positions (x, y, z) with $0 \leq x \leq w$, $0 \leq y \leq h$, $1 \leq z \leq 10$.

The robot may start at any $(0, y_0, 0)$ position where y is an integer, $0 \leq y_0 \leq h$. Its goal is to reach some position $(w, y_1, 0)$, where y_1 is similarly constrained.

Each second, the robot can move 1m in a positive or negative X direction or it can move 1m in a positive or negative Y direction.

At the end of the second, all of the sonar probes emit a ping. The probability of probe i detecting the robot with a ping is $1/d_i^2(x, y)$, where $d_i(x, y)$ is the distance of the robot's location $(x, y, 0)$ from the i$^{\text{th}}$ probe. The probability that the i$^{\text{th}}$ probe fails to detect a robot at $(x, y, 0)$ is therefore $1 - 1/d_i^2(x, y)$, and the probability that none of the probes detect the robot at $(x, y, 0)$ is

$$\prod_{i=1}^{N} \left(1 - \frac{1}{d_i^2(x, y)}\right)$$

If the robot follows a path $((x_0, y_0, 0), (x_1, y_1, 0), \ldots, (x_k, y_k, 0))$, the probability that it will go undetected along the entire path is:

$$\prod_{j=0}^{k} \prod_{i=1}^{N} \left(1 - \frac{1}{d_i^2(x_j, y_j)}\right)$$

Find a path that minimizes the chances of the robot being detected at any point along its journey.

- The ping occurring just after the robot reaches $x = w$ should be included in the probability of detection.
- The robot may not roam outside of the wxh area.
- The robot always has $z = 0$ in its (x, y, z) location.

Input

Input will consist of one or more data sets.

Each data set begins with a line containing a single integer, N, denoting the number of probes. A zero value for N signals the end of input.

The next line of the data set contains two integers w, and h, giving the dimensions of the course. (Note, the legal X coordinates range from 0 to h, inclusive, not from 0 to $h - 1$. Similarly, legal Y coordinates range from 0 to w, inclusive.)

This is followed by N lines, each containing three integers, giving the (x, y, z) coordinates of one probe.

Output

For each data set, print the length of the path that minimizes the probability of the robot being detected during its journey. If there are multiple paths that achieve the same minimum probability, print the length of the shortest such path.

Example

Input:

Given the input

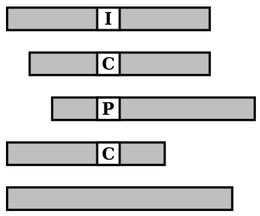
```
4
4 4
2 0 5
2 1 5
2 2 5
2 4 5
8
100 4
2 1 2
2 2 2
2 3 2
2 4 2
99 0 2
99 1 2
99 2 3
99 3 3
0
```

the output would be

Output:

```
4
104
```

Problem H: Verti-Words



Given a target phrase and a paragraph of text, reposition the lines of the paragraph by adding blank characters to the left of each line so that the target phrase appears vertically, reading down, in some column of the rearranged text.

- The original lines of the paragraph may not be split into two or more lines, nor may the characters already within a line be rearranged.
- The characters in the target word must appear on consecutive lines with no blanks or other characters between them. Upper/lower case is significant.

If there are multiple ways to reposition the lines to reveal the target phrase, the tie breakers are, in decreasing order of precedence,

- Minimize the total width of the rearranged paragraph.
- Minimize the total number of inserted blanks.
- Start the target phrase as close to the top of the paragraph as possible.
- Start the target phrase as close to the left as possible.

Input

Input will consist of one or more test cases.

Each test case will begin with a line containing the target phrase, left-justified. A target of "END" signals the end of input.

This is followed by $1 \ldots 20$ lines of text, each up to 80 characters in width, that comprise the paragraph. The end of the paragraph is signaled by an empty line (no characters other than the line termination).

Output

For each test case, print the paragraph with appropriate indentation supplied as blank spaces, denoting the desired solution.

If no solution is possible, print the paragraph unchanged.

Example

Input:

Given the input

```
acm
Given a target word and a paragraph of text,
rearrange the paragraph by adding blank characters to
the left of each line so that the target word appears
vertically in some column,
top-to-bottom in some column of the rearranged text.

Moo
If there are multiple ways to make this happen, tie breakers are,
in decreasing order of precedence,
* Minimize the total width of the rearranged paragraph.
* Minimize the total number of inserted blanks.
* Start the target phrase as close to the top of the paragraph as possible.
* Start the target phrase as close to the left as possible.

END
```

the output would be

Output:

```
Given a target word and a paragraph of text,
rearrange the paragraph by adding blank characters to
the left of each line so that the target word appears
        vertically in some column,
 top-to-bottom in some column of the rearranged text.
If there are multiple ways to make this happen, tie breakers are,
in decreasing order of precedence,
* Minimize the total width of the rearranged paragraph.
                             * Minimize the total number of inserted blanks
* Start the target phrase as close to the top of the paragraph as possible.
* Start the target phrase as close to the left as possible.
```

The target phrases can be seen more clearly below:

```
Given a target word and a paragraph of text,
rearrange the paragraph by adding blank characters to
the left of each line so that the target word appears
        vertically in some column,
 top-to-bottom in some column of the rearranged text.
If there are multiple ways to make this happen, tie breakers are,
in decreasing order of precedence,
* Minimize the total width of the rearranged paragraph.
                             * Minimize the total number of inserted blan
* Start the target phrase as close to the top of the paragraph as possibl
* Start the target phrase as close to the left as possible.
```