# Problem A
# Dictionary

**Input:** **Standard Input**
**Time Limit:** **20 seconds**

We found a dictionary of the Ancient Civilization Mayo (ACM) during excavation of the ruins. After analysis of the dictionary, we revealed they used a language that had not more than 26 letters. So one of us mapped each letter to a different English alphabet and typed all the words in the dictionary into a computer.

How the words are ordered in the dictionary, especially whether they are ordered lexicographically, is an interesting topic to many people. As a good programmer, you are requested to write a program to judge whether we can consider the words to be sorted in a lexicographical order.

Note: In a lexicographical order, a word always precedes other words it is a prefix of. For example, "`ab`" precedes "`abc`", "`abde`", and so on.

## Input

The input consists of multiple datasets. Each dataset is formatted as follows:

> $n$
> $string_1$
> ...
> $string_n$

Each dataset consists of $n + 1$ lines. The first line of each dataset contains an integer that indicates $n$ ($1 \le n \le 500$). The $i$-th line of the following $n$ lines contains $string_i$, which consists of up to 10 English lowercase letters.

The end of the input is "`0`", and this should not be processed.

## Output

Print either "`yes`" or "`no`" in a line for each dataset, in the order of the input. If all words in the dataset can be considered to be ordered lexicographically, print "`yes`". Otherwise, print "`no`".

## Sample Input

```
4
cba
cab
b
a
```

```
3
bca
ab
a
5
abc
acb
b
c
c
5
abc
acb
c
b
b
0
```

## Output for the Sample Input

```
yes
no
yes
no
```

# Problem B
# Texas hold 'em

**Input:** Standard Input
**Time Limit:** 20 seconds

*Texas hold 'em* is one of the standard poker games, originated in Texas, United States. It is played with a standard deck of 52 cards, which has 4 *suits* (spades, hearts, diamonds and clubs) and 13 *ranks* (A, K, Q, J and 10–2), without jokers.

With betting aside, a game goes as described below.

At the beginning each player is dealt with two cards face down. These cards are called *hole cards* or *pocket cards*, and do not have to be revealed until the showdown. Then the dealer deals three cards face up as *community cards*, i.e. cards shared by all players. These three cards are called the *flop*. The flop is followed by another community card called the *turn* then one more community card called the *river*.

After the river, the game goes on to the *showdown*. All players reveal their hole cards at this point. Then each player chooses five out of the seven cards, i.e. their two hole cards and the five community cards, to form a *hand*. The player forming the strongest hand wins the game. There are ten possible kinds of hands, listed from the strongest to the weakest:

- *Royal straight flush*: A, K, Q, J and 10 of the same suit. This is a special case of straight flush.
- *Straight flush*: Five cards in sequence (e.g. 7, 6, 5, 4 and 3) and of the same suit.
- *Four of a kind*: Four cards of the same rank.
- *Full house*: Three cards of the same rank, plus a pair of another rank.
- *Flush*: Five cards of the same suit, but not in sequence.
- *Straight*: Five cards in sequence, but not of the same suit.
- *Three of a kind*: Just three cards of the same rank.
- *Two pairs*: Two cards of the same rank, and two other cards of another same rank.
- *One pair*: Just a pair of cards (two cards) of the same rank.
- *High card*: Any other hand.

For the purpose of a sequence, J, Q and K are treated as 11, 12 and 13 respectively. A can be seen as a rank either next above K or next below 2, thus both A-K-Q-J-10 and 5-4-3-2-A are possible (but not 3-2-A-K-Q or the likes).

If more than one player has the same kind of hand, ties are broken by comparing the ranks of the cards. The basic idea is to compare first those forming sets (pairs, triples or quads) then the rest cards one by one from the highest-ranked to the lowest-ranked, until ties are broken. More specifically:

- *Royal straight flush*: (ties are not broken)
- *Straight flush*: Compare the highest-ranked card.
- *Four of a kind*: Compare the four cards, then the remaining one.
- *Full house*: Compare the three cards, then the pair.

- *Flush*: Compare all cards one by one.
- *Straight*: Compare the highest-ranked card.
- *Three of a kind*: Compare the three cards, then the remaining two.
- *Two pairs*: Compare the higher-ranked pair, then the lower-ranked, then the last one.
- *One pair*: Compare the pair, then the remaining three.
- *High card*: Compare all cards one by one.

The order of the ranks is A, K, Q, J, 10, 9, …, 2, from the highest to the lowest, except for A next to 2 in a straight regarded as lower than 2. Note that there are exceptional cases where ties remain. Also note that the suits are not considered at all in tie-breaking.

Here are a few examples of comparison (note these are only intended for explanatory purpose; some combinations cannot happen in Texas Hold 'em):

- J-J-J-6-3 and K-K-Q-Q-8.

The former beats the latter since three of a kind is stronger than two pairs.

- J-J-J-6-3 and K-Q-8-8-8.

Since both are three of a kind, the triples are considered first, J and 8 in this case. J is higher, hence the former is a stronger hand. The remaining cards, 6-3 and K-Q, are not considered as the tie is already broken.

- Q-J-8-6-3 and Q-J-8-5-3.

Both are high cards, assuming hands not of a single suit (i.e. flush). The three highest-ranked cards Q-J-8 are the same, so the fourth highest are compared. The former is stronger since 6 is higher than 5.

- 9-9-Q-7-2 and 9-9-J-8-5.

Both are one pair, with the pair of the same rank (9). So the remaining cards, Q-7-2 and J-8-5, are compared from the highest to the lowest, and the former wins as Q is higher than J.

Now suppose you are playing a game of Texas Hold 'em with one opponent, and the hole cards and the flop have already been dealt. You are surprisingly telepathic and able to know the cards the opponent has. Your ability is not, however, as strong as you can predict which the turn and the river will be.

Your task is to write a program that calculates the probability of your winning the game, assuming the turn and the river are chosen uniformly randomly from the remaining cards. You and the opponent always have to choose the hand strongest possible. Ties should be included in the calculation, i.e. should be counted as losses.

# Input

The input consists of multiple datasets, each of which has the following format:

$YourCard_1$ $YourCard_2$
$OpponentCard_1$ $OpponentCard_2$
$CommunityCard_1$ $CommunityCard_2$ $CommunityCard_3$

Each dataset consists of three lines. The first and second lines contain the hole cards of yours and the opponent's respectively. The third line contains the flop, i.e. the first three community cards. These cards are separated by spaces.

Each card is represented by two characters. The first one indicates the suit: `S` (spades), `H` (hearts), `D` (diamonds) or `C` (clubs). The second one indicates the rank: `A`, `K`, `Q`, `J`, `T` (10) or `9`–`2`.

The end of the input is indicated by a line with "`#`". This should not be processed.

## Output

Print the probability in a line. The number may contain an arbitrary number of digits after the decimal point, but should not contain an absolute error greater than $10^{-6}$.

## Sample Input

```
SA SK
DA CA
SQ SJ ST
SA HA
D2 C3
H4 S5 DA
HA D9
H6 C9
H3 H4 H5
#
```

## Output for the Sample Input

```
1.00000000000000000000
0.34444444444444444198
0.63030303030303025391
```

# Problem C
# Median Tree

**Input:** **Standard Input**
**Time Limit:** **20 seconds**

You are given a connected undirected graph which has even numbers of nodes. A connected graph is a graph in which all nodes are connected directly or indirectly by edges.

Your task is to find a spanning tree whose median value of edges' costs is minimum. A spanning tree of a graph means that a tree which contains all nodes of the graph.

## Input

The input consists of multiple datasets.

The format of each dataset is as follows.

$n$ $m$
$s_1$ $t_1$ $c_1$
...
$s_m$ $t_m$ $c_m$

The first line contains an even number $n$ ($2 \leq n \leq 1{,}000$) and an integer $m$ ($n - 1 \leq m \leq 10{,}000$). $n$ is the nubmer of nodes and $m$ is the number of edges in the graph.

Then $m$ lines follow, each of which contains $s_i$ ($1 \leq s_i \leq n$), $t_i$ ($1 \leq s_i \leq n, t_i \neq s_i$) and $c_i$ ($1 \leq c_i \leq 1{,}000$). This means there is an edge between the nodes $s_i$ and $t_i$ and its cost is $c_i$. There is no more than one edge which connects $s_i$ and $t_i$.

The input terminates when $n = 0$ and $m = 0$. Your program must not output anything for this case.

## Output

Print the median value in a line for each dataset.

## Sample Input

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

```
2 4 5
3 4 6
8 17
1 4 767
3 1 609
8 3 426
6 5 972
8 1 607
6 4 51
5 1 683
3 6 451
3 4 630
8 7 912
3 7 43
4 7 421
3 5 582
8 4 538
5 7 832
1 6 345
8 2 608
0 0
```

## Output for the Sample Input

```
5
2
421
```

# Problem D
# Billiard

**Input: Standard Input**
**Time Limit: 20 seconds**

You have a billiard table. The playing area of the table is rectangular. This billiard table is special as it has no pockets, and the playing area is completely surrounded with a cushion.

You succeeded in producing a ultra-precision billiards playing robot. When you put some balls on the table, the machine hits one of those balls. The hit ball stops after 10,000 unit distance in total moved.

When a ball collided with the cushion of the table, the ball takes the orbit like mirror reflection. When a ball collided with the corner, the ball bounces back on the course that came.

Your mission is to predict which ball collides first with the ball which the robot hits .

## Input

The input is a sequence of datasets. The number of datasets is less than 100. Each dataset is formatted as follows.

$n$
$w$ $h$ $r$ $v_x$ $v_y$
$x_1$ $y_1$
...
$x_n$ $y_n$

First line of a dataset contains an positive integer $n$, which represents the number of balls on the table ($2 \leq n \leq 11$). The next line contains five integers ($w$, $h$, $r$, $v_x$, $v_y$) separated by a single space, where $w$ and $h$ are the width and the length of the playing area of the table respectively ($4 \leq w, h \leq 1{,}000$), $r$ is the radius of the balls ($1 \leq r \leq 100$). The robot hits the ball in the vector $(v_x, v_y)$ direction ($-10{,}000 \leq v_x, v_y \leq 10{,}000$ and $(v_x, v_y) \neq (0, 0)$ ).

The following $n$ lines give position of balls. Each line consists two integers separated by a single space, $(x_i, y_i)$ means the center position of the $i$-th ball on the table in the initial state ($r < x_i < w - r$, $r < y_i < h - r$). $(0, 0)$ indicates the position of the north-west corner of the playing area, and $(w, h)$ indicates the position of the south-east corner of the playing area. You can assume that, in the initial state, the balls do not touch each other nor the cushion.

The robot always hits the first ball in the list. You can assume that the given values do not have errors.

The end of the input is indicated by a line containing a single zero.

## Output

For each dataset, print the index of the ball which first collides with the ball the robot hits. When the hit ball collides with no ball until it stops moving, print "-1".

You can assume that no more than one ball collides with the hit ball first, at the same time.

It is also guaranteed that, when $r$ changes by $eps$ ($eps < 10^{-9}$), the ball which collides first and the way of the collision do not change.

## Sample Input

```
3
26 16 1 8 4
10 6
9 2
9 10
3
71 363 4 8 0
52 238
25 33
59 288
0
```

## Output for the Sample Input

```
3
-1
```

# Problem E
# Stack Maze

**Input: Standard Input**
**Time Limit: 20 seconds**

There is a maze which can be described as a $W \times H$ grid. The upper-left cell is denoted as (1, 1), and the lower-right cell is $(W, H)$. You are now at the cell (1, 1) and have to go to the cell $(W, H)$. However, you can only move to the right adjacent cell or to the lower adjacent cell. The following figure is an example of a maze.

```
...#......
a###.#####
.bc...A...
##.#C#d#.#
.#B#.#.###
.#...#e.D.
.#A..###.#
..e.c#..E.
####d###.#
#....#.#.#
##E...d.C.
```

In the maze, some cells are free (denoted by '`.`') and some cells are occupied by rocks (denoted by '`#`'), where you cannot enter. Also there are jewels (denoted by lowercase alphabets) in some of the free cells and holes to place jewels (denoted by uppercase alphabets). Different alphabets correspond to different types of jewels, i.e. a cell denoted by '`a`' contains a jewel of type A, and a cell denoted by '`A`' contains a hole to place a jewel of type A. It is said that, when we place a jewel to a corresponding hole, something happy will happen.

At the cells with jewels, you can choose whether you pick a jewel or not. Similarly, at the cells with holes, you can choose whether you place a jewel you have or not. Initially you do not have any jewels. You have a very big bag, so you can bring arbitrarily many jewels. However, your bag is a stack, that is, you can only place the jewel that you picked up last.

On the way from cell (1, 1) to cell $(W, H)$, how many jewels can you place to correct holes?

## Input

The input contains a sequence of datasets. The end of the input is indicated by a line containing two zeroes. Each dataset is formatted as follows.

$H$ $W$
$C_{11}$ $C_{12}$ ... $C_{1W}$
$C_{21}$ $C_{22}$ ... $C_{2W}$

...
$C_{H1}$ $C_{H2}$ ... $C_{HW}$

Here, $H$ and $W$ are the height and width of the grid. You may assume $1 \leq W, H \leq 50$. The rest of the datasets consists of $H$ lines, each of which is composed of $W$ letters. Each letter $C_{ij}$ specifies the type of the cell $(i, j)$ as described before. It is guaranteed that $C_{11}$ and $C_{WH}$ are never '#'.

You may also assume that each lowercase or uppercase alphabet appear at most 10 times in each dataset.

## Output

For each dataset, output the maximum number of jewels that you can place to corresponding holes. If you cannot reach the cell $(W, H)$, output -1.

## Sample Input

```
3 3
ac#
b#C
.BA
3 3
aaZ
a#Z
aZZ
3 3
..#
.#.
#..
1 50
abcdefghijklmnopqrstuvwxyYXWVUTSRQPONMLKJIHGFEDCBA
1 50
aAbBcCdDeEfFgGhHiIjJkKlLmMnNoOpPqQrRsStTuUvVwWxXyY
1 50
abcdefghijklmnopqrstuvwxyABCDEFGHIJKLMNOPQRSTUVWXY
1 50
aaaaaaaaaabbbbbbbbbbcccccCCCCCBBBBBBBBBBAAAAAAAAAA
10 10
...#......
a###.#####
.bc...A...
##.#C#d#.#
.#B#.#.###
.#...#e.D.
.#A..###.#
..e.c#..E.
####d###.#
##E...D.C.
0 0
```

## Output for the Sample Input

```
2
0
-1
25
25
1
25
4
```

# Problem F
# Counting 1's

**Input: Standard Input**
**Time Limit: 20 seconds**

Let $b_i(x)$ be the $i$-th least significant bit of $x$, i.e. the $i$-th least significant digit of $x$ in base 2 ($i \geq 1$). For example, since $6 = (110)_2$, $b_1(6) = 0$, $b_2(6) = 1$, $b_3(6) = 1$, $b_4(6) = 0$, $b_5(6) = 0$, and so on.

Let $A$ and $B$ be integers that satisfy $1 \leq A \leq B \leq 10^{18}$, and $k_i$ be the number of integers $x$ such that $A \leq x \leq B$ and $b_i(x) = 1$.

Your task is to write a program that determines $A$ and $B$ for a given $\{k_i\}$.

## Input

The input consists of multiple datasets. The number of datasets is no more than 100,000. Each dataset has the following format:

$n$
$k_1$
$k_2$
...
$k_n$

The first line of each dataset contains an integer $n$ ($1 \leq n \leq 64$). Then $n$ lines follow, each of which contains $k_i$ ($0 \leq k_i \leq 2^{63} - 1$). For all $i > n$, $k_i = 0$.

The input is terminated by $n = 0$. Your program must not produce output for it.

## Output

For each dataset, print one line.

- If $A$ and $B$ can be uniquely determined, output $A$ and $B$. Separate the numbers by a single space.
- If there exists more than one possible pair of $A$ and $B$, output "`Many`" (without quotes).
- Otherwise, i.e. if there exists no possible pair, output "`None`" (without quotes).

## Sample Input

```
3
2
2
```

1
49
95351238128934
95351238128934
95351238128932
95351238128936
95351238128936
95351238128936
95351238128960
95351238128900
95351238128896
95351238129096
95351238128772
95351238129096
95351238129096
95351238126156
95351238131712
95351238131712
95351238149576
95351238093388
95351238084040
95351237962316
95351238295552
95351237911684
95351237911684
95351235149824
95351233717380
95351249496652
95351249496652
95351226761216
95351226761216
95351082722436
95351082722436
95352054803020
95352156464260
95348273971200
95348273971200
95354202286668
95356451431556
95356451431556
95346024826312
95356451431556
95356451431556
94557999988736
94256939803780
94256939803780
102741546035788
87649443431880
87649443431880
140737488355328
32684288648324

64
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

50
51
52
53
54
55
56
57
58
59
60
61
62
63
11
0
0
1
1
1
0
1
1
1
1
1
63
0
0
0
0
0
0
0
0
0
0
0
0
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0
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0
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0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
1
4
1
1
1
1
0
```

## Output for the Sample Input

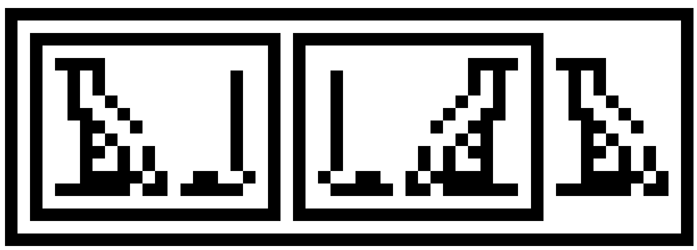
```
1 4
123456789101112 314159265358979
None
```

```
2012 2012
None
Many
```

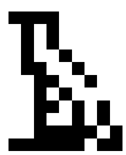
# Problem G
# Ancient Commemorative Monolith

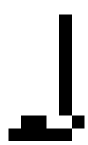
**Input: Standard Input**
**Time Limit: 20 seconds**

One day in a forest, Alice found an old monolith.



She investigated the monolith, and found this was a sentence written in an old language. A sentence consists of glyphs and rectangles which surrounds them. For the above example, there are following glyphs.





Notice that some glyphs are flipped horizontally in a sentence.

She decided to transliterate it using ASCII letters assigning an alphabet to each glyph, and '`[`' and '`]`' to rectangles. If a sentence contains a flipped glyph, she transliterates it from right to left. For example, she could assign '`a`' and '`b`' to the above glyphs respectively. Then the above sentence would be transliterated into "`[[ab][ab]a]`".

After examining the sentence, Alice figured out that the sentence was organized by the following structure:

- A sentence ⟨seq⟩ is a sequence consists of zero or more ⟨term⟩s.
- A term ⟨term⟩ is either a glyph or a ⟨box⟩. A glyph may be flipped.
- ⟨box⟩ is a rectangle surrounding a ⟨seq⟩. The height of a box is larger than any glyphs inside.

Now, the sentence written on the monolith is a nonempty ⟨seq⟩. Each term in the sequence fits in a rectangular bounding box, although the boxes are not explicitly indicated for glyphs. Those bounding boxes for adjacent terms have no overlap to each other. Alice formalized the transliteration rules as follows.

Let $f$ be the transliterate function.

Each sequence $s = t_1 t_2 \cdots t_m$ is written either from left to right, or from right to left. However, please note here $t_1$ corresponds to the leftmost term in the sentence, $t_2$ to the 2nd term from the left, and so on.

Let's define $\bar{g}$ to be the flipped glyph $g$. A sequence must have been written from right to left, when a sequence contains one or more single-glyph term which is unreadable without flipping, i.e. there exists an integer $i$ where $t_i$ is a single glyph $g$, and $g$ is not in the glyph dictionary given separately whereas $\bar{g}$ is. In such cases $f(s)$ is defined to be $f(t_m)f(t_{m-1})\cdots f(t_1)$, otherwise $f(s) = f(t_1)f(t_2)\cdots f(t_m)$. It is guaranteed that all the glyphs in the sequence are flipped if there is one or more glyph which is unreadable without flipping.

If the term $t_i$ is a box enclosing a sequence $s'$, $f(t_i)$ = '`[`'$f(s')$'`]`'. If the term $t_i$ is a glyph $g$, $f(t_i)$ is mapped to an alphabet letter corresponding to the glyph $g$, or $\bar{g}$ if the sequence containing $g$ is written from right to left.

Please make a program to transliterate the sentences on the monoliths to help Alice.

# Input

The input consists of several datasets. The end of the input is denoted by two zeros separated by a single-space.

Each dataset has the following format.

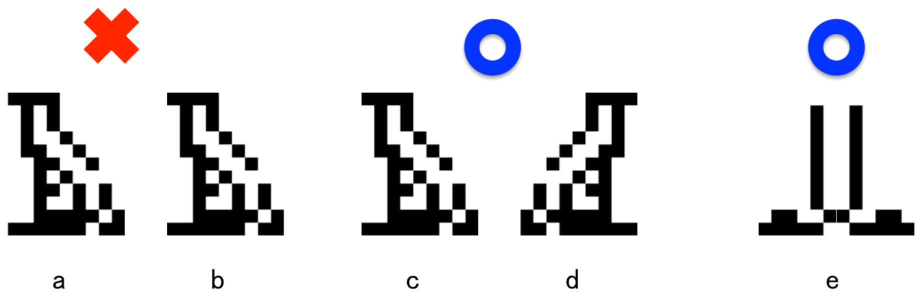
> $n$ $m$
> $glyph_1$
> ...
> $glyph_n$
> $string_1$
> ...
> $string_m$

$n$ $(1 \le n \le 26)$ is the number of glyphs and $m$ $(1 \le m \le 10)$ is the number of monoliths. $glyph_i$ is given by the following format.

> $c$ $h$ $w$
> $b_{11}...b_{1w}$
> ...
> $b_{h1}...b_{hw}$

$c$ is a lower-case alphabet that Alice assigned to the glyph. $h$ and $w$ $(1 \le h \le 15,\ 1 \le w \le 15)$ specify the height and width of the bitmap of the glyph, respectively. The matrix $b$ indicates the bitmap. A white cell is represented by '`.`' and a black cell is represented by '`*`'.

You can assume that all the glyphs are assigned distinct characters. You can assume that every column of the bitmap contains at least one black cell, and the first and last row of the bitmap contains at least one black cell. Every bitmap is different to each other, but it is possible that a flipped bitmap is same to another bitmap. Moreover there may be symmetric bitmaps.




$string_i$ is given by the following format.

> $h$ $w$
> $b_{11}...b_{1w}$
> ...
> $b_{h1}...b_{hw}$

$h$ and $w$ ($1 \leq h \leq 100$, $1 \leq w \leq 1000$) is the height and width of the bitmap of the sequence. Similarly to the glyph dictionary, $b$ indicates the bitmap where A white cell is represented by '`.`' and a black cell by '`*`'.

There is no noise: every black cell in the bitmap belongs to either one glyph or one rectangle box. The height of a rectangle is at least 3 and more than the maximum height of the tallest glyph. The width of a rectangle is at least 3.

A box must have a margin of 1 pixel around the edge of it.

You can assume the glyphs are never arranged vertically. Moreover, you can assume that if two rectangles, or a rectangle and a glyph, are in the same column, then one of them contains the other. For all bounding boxes of glyphs and black cells of rectangles, there is at least one white cell between every two of them. You can assume at least one cell in the bitmap is black.

## Output

For each monolith, output the transliterated sentence in one line. After the output for one dataset, output '`#`' in one line.

## Sample Input

```
2 1
a 11 9
****.....
.*.*.....
```

```
.*.*.....
.*..*....
.**..*...
..**..*..
..*.*....
..**.*.*.
..*..*.*.
..*****.*
******.**
b 10 6
....*.
....*.
....*.
....*.
....*.
....*.
....*.
....*.
.**..*
*****.
19 55
*******************************************************
*.....................................................*
*.********************.********************...........*
*.*..................*.*..................*...........*
*.*.****.............*.*.............****.*.****......*
*.*..*.*..........*..*.*..*..........*.*..*..*.*......*
*.*..*.*..........*..*.*..*..........*.*..*..*.*......*
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*.*..**..*........*..*.*..*........*..**..*..**..*....*
*.*...**..*.......*..*.*..*.......*..**...*...**..*...*
*.*...*.*.........*..*.*..*.........*.*...*...*.*.....*
*.*...**.*.*......*..*.*..*......*.*.**...*...**.*.*..*
*.*...*..*.*......*..*.*..*......*.*..*...*...*..*.*..*
*.*...*****.*..**..*.*.*.*..**..*.*****...*...*****.*.*
*.*.******.**.*****..*.*..*****.**.******.*.******.**.*
*.*..................*.*..................*...........*
*.********************.********************...........*
*.....................................................*
*******************************************************
2 3
a 2 3
.*.
***
b 3 3
.*.
***
.*.
2 3
.*.
***
```

```
4 3
***
*.*
*.*
***
9 13
************.
*..........*.
*.......*..*.
*...*..***.*.
*..***.....*.
*...*......*.
*..........*.
************.
.............
3 1
a 2 2
.*
**
b 2 1
*
*
c 3 3
***
*.*
***
11 16
****************
*..............*
*....*********.*
*....*.......*.*
*.*..*.***...*.*
*.**.*.*.*.*.*.*
*....*.***.*.*.*
*....*.......*.*
*....*********.*
*..............*
****************
0 0
```

## Output for the Sample Input

```
[[ab][ab]a]
#
a
[]
[ba]
#
[[cb]a]
#
```

# Problem H
# Magical Bridges

**Input: Standard Input**
**Time Limit: 20 seconds**

A magician lives in a country which consists of $N$ islands and $M$ bridges. Some of the bridges are magical bridges, which are created by the magician. Her magic can change all the lengths of the magical bridges to the same non-negative integer simultaneously.

This country has a famous 2-player race game. Player 1 starts from island $S_1$ and Player 2 starts from island $S_2$. A player who reached the island $T$ first is a winner.

Since the magician loves to watch this game, she decided to make the game most exiting by changing the length of the magical bridges so that the difference between the shortest-path distance from $S_1$ to $T$ and the shortest-path distance from $S_2$ to $T$ is as small as possible. We ignore the movement inside the islands.

Your job is to calculate how small the gap can be.

Note that she assigns a length of the magical bridges before the race starts *once*, and does not change the length *during the race*.

## Input

The input consists of several datasets. The end of the input is denoted by five zeros separated by a single-space. Each dataset obeys *the* following format. Every number in the inputs is integer.

$N$ $M$ $S_1$ $S_2$ $T$
$a_1$ $b_1$ $w_1$
$a_2$ $b_2$ $w_2$
...
$a_M$ $b_M$ $w_M$

$(a_i, b_i)$ indicates the bridge $i$ connects the two islands $a_i$ and $b_i$.

$w_i$ is either a non-negative integer or a letter '`x`' (quotes for clarity). If $w_i$ is an integer, it indicates the bridge $i$ is normal and its length is $w_i$. Otherwise, it indicates the bridge $i$ is magical.

You can assume the following:

- $1 \leq N \leq 1{,}000$
- $1 \leq M \leq 2{,}000$
- $1 \leq S_1, S_2, T \leq N$
- $S_1, S_2, T$ are all different.

- $1 \leq a_i, b_i \leq N$
- $a_i \neq b_i$
- For all normal bridge $i$, $0 \leq w_i \leq 1{,}000{,}000{,}000$
- The number of magical bridges $\leq 100$

## Output

For each dataset, print the answer in a line.

## Sample Input

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

## Output for the Sample Input

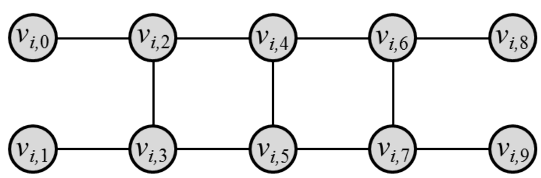
```
1
1
```

# Problem I
# Hashigo Sama

**Input: Standard Input**
**Time Limit: 20 seconds**

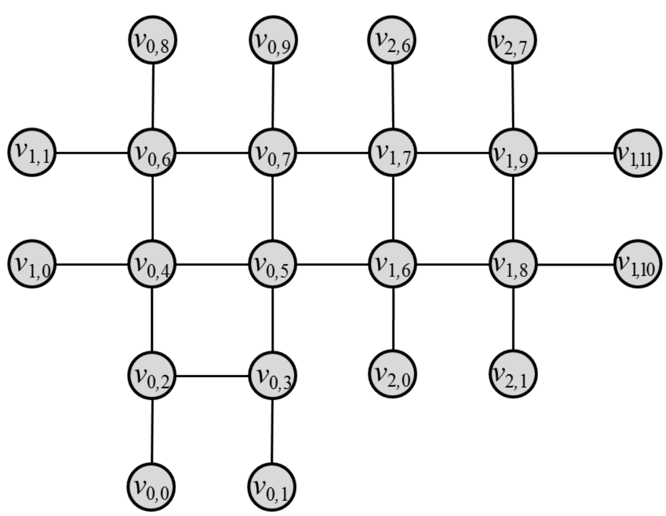
Chelsea is a modern artist. She decided to make her next work with ladders. She wants to combine some ladders and paint some beautiful pattern.

A ladder can be considered as a graph called *hashigo*. There are $n$ *hashigos* numbered from 0 to $n-1$. *Hashigo* $i$ of length $l_i$ has $2l_i+6$ vertices $v_{i,0}, v_{i,1}, ..., v_{i,2l_i+5}$ and has edges between the pair of vertices $(v_{i,j}, v_{i,j+2})$ $(0 \leq j \leq 2l_i+3)$ and $(v_{i,2j}, v_{i,2j+1})$ $(1 \leq j \leq l_i+1)$. The figure below is example of a *hashigo* of length 2. This corresponds to the graph given in the first dataset in the sample input.




Two *hashigos* $i$ and $j$ are combined at position $p$ $(0 \leq p \leq l_i - 1)$ and $q$ $(0 \leq q \leq l_j - 1)$ by marged each pair of vertices $(v_{i,2p+2}, v_{j,2q+2})$, $(v_{i,2p+3}, v_{j,2q+4})$, $(v_{i,2p+4}, v_{j,2q+3})$ and $(v_{i,2p+5}, v_{j,2q+5})$.

Chelsea performs this operation $n-1$ times to combine the $n$ *hashigos*. After this operation, the graph should be connected and the maximum degree of the graph should not exceed 4. The figure below is a example of the graph obtained by combining three *hashigos*. This corresponds to the graph given in the second dataset in the sample input.



Now she decided to paint each vertex by black or white with satisfying the following condition:

- The maximum components formed by the connected vertices painted by the same color is less than or equals to $k$.

She would like to try all the patterns and choose the best. However, the number of painting way can be very huge. Since she is not good at math nor computing, she cannot calculate the number. So please help her with your superb programming skill!

## Input

The input contains several datasets, and each dataset is in the following format.

$n$ $k$
$l_0$ $l_1$ ... $l_{n-1}$
$f_0$ $p_0$ $t_0$ $q_0$
...
$f_{n-2}$ $p_{n-2}$ $t_{n-2}$ $q_{n-2}$

The first line contains two integers $n$ $(1 \leq n \leq 30)$ and $k$ $(1 \leq k \leq 8)$.

The next line contains $n$ integers $l_i$ $(1 \leq l_i \leq 30)$, each denotes the length of *hashigo* $i$.

The following $n-1$ lines each contains four integers $f_i$ $(0 \leq f_i \leq n-1)$, $p_i$ $(0 \leq p_i \leq l_{f_i}-1)$, $t_i$ $(0 \leq t_i \leq n-1)$, $q_i$ $(0 \leq q_i \leq l_{t_i}-1)$. It represents the *hashigo* $f_i$ and the *hashigo* $t_i$ are combined at the position $p_i$ and the position $q_i$. You may assume that the graph obtained by combining $n$ *hashigos* is connected and the degree of each vertex of the graph does not exceed 4.

The last dataset is followed by a line containing two zeros.

## Output

For each dataset, print the number of different colorings modulo 1,000,000,007 in a line.

## Sample Input

```
1 5
2
3 7
2 3 1
0 1 1 0
1 2 2 0
2 8
5 6
0 2 1 2
2 8
1 1
0 0 1 0
```

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

## Output for the Sample Input

```
708
1900484
438404500
3878
496
14246
9768
```

# Problem J
# Ancient Scrolls

**Input: Standard Input**
**Time Limit: 20 seconds**

You bought 3 ancient scrolls from a magician. These scrolls have a long string, and the lengths of the strings are the same. He said that these scrolls are copies of the key string to enter a dungeon with a secret treasure. However, he also said, they were copied so many times by hand, so the string will contain some errors, though the length seems correct.

Your job is to recover the original string from these strings. When finding the original string, you decided to use the following assumption.

- The copied string will contain at most $d$ errors. In other words, the Hamming distance of the original string and the copied string is at most $d$.
- If there exist many candidates, the lexicographically minimum string is the original string.

Can you find the orignal string?

## Input

The input contains a series of datasets.

Each dataset has the following format:

$l$ $d$
$str_1$
$str_2$
$str_3$

The first line contains two integers $l$ $(1 \le l \le 100{,}000)$ and $d$ $(0 \le d \le 5{,}000.)$ $l$ describes the length of 3 given strings and $d$ describes acceptable maximal Hamming distance. The following 3 lines have given strings, whose lengths are $l$. These 3 strings consist of only lower and upper case alphabets.

The input ends with a line containing two zeros, which should not be processed.

## Output

Print the lexicographically minimum satisfying the condition in a line. If there do not exist such strings, print "`-1`".

## Sample Input

```
3 1
```

```
ACM
IBM
ICM
5 2
iwzwz
iziwi
zwizi
1 0
A
B
C
10 5
jLRNlNyGWx
yyLnlyyGDA
yLRnvyyGDA
0 0
```

## Output for the Sample Input

```
ICM
iwiwi
-1
AARAlNyGDA
```