2004 Canadian Computing Competition, Stage 2
Day 1, Question 1

Input file: `scribble.in` or standard input
Output file: `scribble.out` or standard output
Source file: `n:\scribble\scribble.___`

Scribble

Nixed, he placed the flong into the calathi halfway through the yuga.

Huh?

Believe it or not, the above sentence is actually a valid English sentence. It also has two other features: it looks like spam, and the words are very valuable.

Valuable, you say? (For some reason, you are doing lots of talking to yourself today).

Yes, valuable, if you are playing Scribble. In the standard game of Scribble, calathi (which means "a vase-shaped basket represented in Greek painting and sculpture") is worth 72 points, nixed (meaning "refused") is worth 26 points, flong (which is "a compressed mass of paper sheets, forming a matrix or mold for stereotype plates") is worth 18 points, and yuga which is "any one of the four ages, Krita, or Satya, Treta, Dwapara, and Kali, into which the Hindus divide the duration or existence of the world" is worth 33 points.

Specifically, as you may know, each letter in Scribble is worth a given number of points. The goal is get the most points with a given set of letters.

For this question, we will modify the game slightly. Suppose you have 7 tiles/letters and you have scores for each letter (where the score s_α for each letter α satisfies $0 < s_\alpha \leq 26$), and also you have a dictionary of valid words that you can consult before you play (this is different than the "normal" Scribble play). Your task is the find the highest scoring word.

Input description

You are given a number k ($1 \leq k \leq 7$) on the first line of input. On the next k lines, you will be given triples α s_α r_α, where α is a letter, s_α is the score for that letter, and r_α is the number of times that letter occurs as a tile. You can assume that

$$\sum_\alpha r_\alpha = 7.$$

For example, the triple "a 7 2" means you have two tiles marked a and each is worth 7 points. On the next (the $k+2$nd) line, there is the number N ($0 < N < 100000$). On each of the next N lines, there is a word (you can assume the length of each word is at least one).

Output Description

The output one line long, containing one integer, which is the maximum score. That is, the maximum number of points that can be attained by using the tiles to form one complete word. If no word can be formed, the maximum number of points is zero.

Sample Input

```
4
a 1 1
b 4 1
c 2 1
d 10 4
3
ab
bc
c
```

Sample Output

```
6
```

2004 Canadian Computing Competition, Stage 2
Day 1, Question 2

Input file: `hockey.in` or standard input
Output file: `hockey.out` or standard output
Source file: `n:\hockey\hockey.___`

Hockey Scores

Hugh Hockey is a very big hockey fan. Every Saturday night he sits and watches all the hockey games, never wanting to miss a moment. Every Canadian loves hockey.

Not this Saturday night though. Hugh Hockey has a date, so he trained his three year-old brother Billy to record the scores for him. He sits Billy in front of his TV, teaches him how to change the channels, and tells him to write down the hockey scores.

Hugh returns home, after his date, to a surprise: he discovers that even though Billy wrote down the scores, Billy didn't write down the names of the teams. He also discovered that Billy not only wrote down the final scores, but also the scores of games in progress. To make matters worse, Billy didn't follow any specific order when writing down the score of a game; A score of two-to-one could have been written down as $2-1$ or $1-2$. There's no guarantee that Billy wrote down every score, some could be missed.

Help Hugh figure out, from Billy's list, the minimum number of hockey games that occured, so Hugh knows, sadly, how much hockey he's missed.

Input

Input consists of a series of test cases. The first line consists of an integer n, the number of test cases.

For each test case, the first line consists of the integer s, $(1 \leq s \leq 1000)$, the number of hockey scores recorded by Billy. The next s lines each contain a hockey score in the form $x - y$, where x and y are non-negative integers.

Output

For each test case, output on a single line the integer m, the minimum number of games that must have occured such that each score Billy recorded occurs in a game sometime during the night. The next m lines give a possible scenario for the hockey games, such that each score Billy recorded is used at least once (and scores that Billy did not record do not appear).

If there is more than one possible scenario for the hockey scores, any one will do.

Sample Input

```
2
4
```

```
1-0
2-0
0-3
2-1
4
0-0
5-0
1-3
2-2
```

Sample Output

```
2
1-0 2-0 3-0
2-1
3
0-0 5-0
3-1
2-2
```

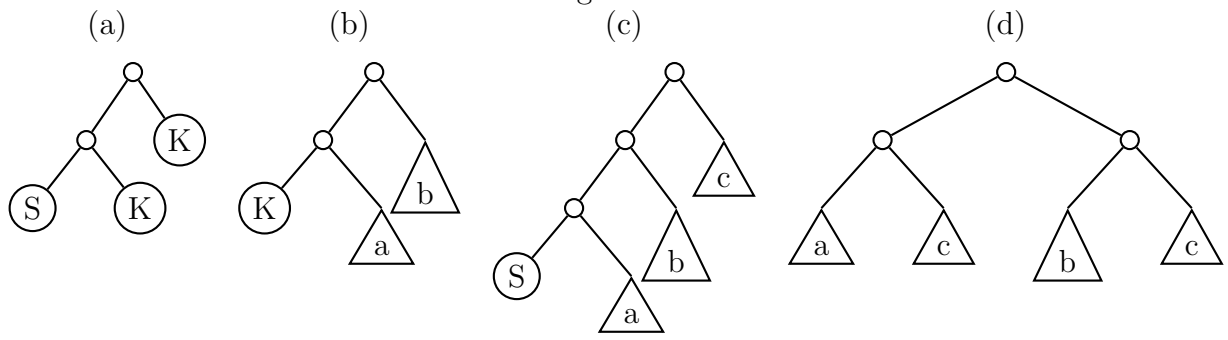
2004 Canadian Computing Competition, Stage 2
Day 1, Question 3

Input file: `sk.in` or standard input
Output file: `sk.out` or standard output
Source file: `n:\sk\sk.___`

S and K

You may be wondering what is the simplest computer we can create that can still perform useful computation. Over the years, theoretical computer scientists have devised various simple models of computation such as Turing machines and lambda calculus. In this problem, we will see how we can perform arbitrary computation in an even simpler system devised in 1924 by Moses Schönfinkel, using just the letters S and K. We will arrange these letters in a binary tree to provide some structure. Specifically, we will manipulate binary trees in which every leaf node is either an S or K. An example of such a tree is shown in Figure 1(a).

Figure 1:



We can encode such a binary tree as a string in the following way. To represent a leaf node, we write either `S` or `K`. To represent a non-leaf node, we write `(`ab`)`, replacing a with the string representation of the left child and b with the string representation of the right child. For example, the tree in Figure 1(a) would be represented by the string `((SK)K)`.

The binary trees are transformed according to the following rules, which will attempt to apply in the order given. That is, we will try to apply rule (1) first, and if we can't, we will try to apply rule (2) next, and so on. Once we have applied a rule, we would begin checking at rule (1) on the root of the tree.

1. If the tree has the form of Figure 1(b), where a and b are arbitrary subtrees, we replace it with only the subtree a. In string form, if the string representation has the form `((K`a`)`b`)`, where a and b are the string representations of some arbitrary subtrees, we replace it with just a.

2. If the tree has the form of Figure 1(c), where a, b, and c are arbitrary subtrees, we replace it with the tree shown in Figure 1(d), which contains one copy each of a and b,

and two copies of c. In string form, we are replacing a string of the form $(((\mathtt{S}a)b)c)$ with $((ac)(bc))$.

3. If we cannot find any transformation to perform using any of the preceding rules, we recursively apply the these transformation rules to the subtree rooted at the left child of the root.

4. If we cannot find any transformation to perform using any of the preceding rules, we recursively apply the these transformation rules to the subtree rooted at the right child of the root.

5. If we cannot find any transformation to perform using any of the preceding rules, we print out the string representation of the resulting tree and stop.

How do we use these simple rules to perform computations? We can start by defining a representation of natural numbers. Many representations are possible, but the following is the most popular, devised by Alonzo Church. We will define zero to be $0 = (K((SK)K))$, and a successor operator $\sigma = (S((S(KS))K))$. We can then define the natural numbers as $1 = (\sigma 0)$, $2 = (\sigma 1)$, $3 = (\sigma 2)$, and so on, always replacing each symbol such as σ and 0 by the subtree we defined for it. So the number 4 will be represented by the tree

$$4 = ((S((S(KS))K))((S((S(KS))K))((S((S(KS))K))((S((S(KS))K))(K((SK)K))))))$$

Notice that this has four occurrences of the subtree σ, followed by the subtree 0.

Numbers encoded in this way can be added using the subtree

$$+ = ((S((SK)K))(K(S((S(KS))K))))$$

For example, if we construct the tree $((+3)4)$, again replacing $+$, 3, and 4 by the appropriate subtrees, and apply the transformation rules, we will eventually end up with the tree 7. Multiplication can be performed using the simpler subtree $* = ((S(KS))K)$. However, the results produced using some operators such as $*$ may not look like the numbers we just defined, although they are equivalent in that they behave the same way. We can use a normalization operator

$$N = ((S((S((SK)K))(K(S((S(KS))K)))))(K(K((SK)K))))$$

to make them look the same if they are equivalent. So, applying the transformation rules to the tree $(N((*2)4))$ produces the tree 8.

With a bit more playing around, we can come up with trees for other operations one might expect in a programming language, such as comparisons, conditionals, and recursion. These operators can be used to write more complicated programs. For example, the following tree computes factorials:

$$! = ((((SS)K)((S(K((SS)(S((SS)K)))))K))((S(K(S((S((S((S((SK)K))(K(K(K((SK)K))))))$$

$$(KK)))(K((S((S(KS))K))(K((SK)K)))))))((S(K(S((S(KS))K))))((S((S(KS))K))$$

$$(K((S(K(S(K(S(K((S((SK)K))(K(K((SK)K)))))))))((S((S(KS))((S(K(S(KS))))$$
$$((S(K(S(KK))))((S((S(KS))K))(K((S((S(KS))((S(K(S(K((S((S(KS))((S(KK))((S(KS))$$
$$((S(K(S((SK)K))))K)))))(KK))))))((S((S(KS))K))(K((S((SK)K))(KK)))))))$$
$$(K((S((SK)K))(KK)))))))))(K(K((S((S((S(KS))((S(KK))((S(KS))$$
$$((S(K(S((SK)K))))K)))))(KK)))((SK)K)))))))))))$$

If we combine it with the normalization operator and the number 4, for example, and apply the transformation rules to the tree $(N(!4))$, we end up with the tree representing 24 (which is 4!).

Input Specification

The input will consist of several strings representing trees, one tree on each line. No input line will contain more than 1000 characters. The last line of input will be blank.

Output Specification

For each line of input except the last blank line, your program must repeatedly apply the transformation rules to the given tree, until no further transformations are possible (rule 5). It must then print out, on a single line, the string representation of the resulting tree. Although for some trees, such as

$$(((S((SK)K))((SK)K))((S((SK)K))((SK)K)))$$

it is possible to continue applying the rules forever, we will not include any such trees in the test data.

Sample Input

```
((KS)K)
((KK)S)
(((SK)S)K)
(((SS)K)S)
(((SK)K)K)
((((S((SK)K))(K(S((S(KS))K))))((S((S(KS))K))(K((SK)K))))((S((S(KS))K))(K((SK)K))))
(((S((S((SK)K))(K(S((S(KS))K)))))(K(K((SK)K))))(((S((S(KS))K))((SK)K))((S((S(KS))K))((SK)K))))
```

Sample Output

```
S
K
K
((SS)(KS))
K
((S((S(KS))K))((S((S(KS))K))(K((SK)K))))
((S((S(KS))K))((S((S(KS))K))((S((S(KS))K))((S((S(KS))K))(K((SK)K))))))
```