2210 Consumer Behavior Study

A major shopping complex opens in Singapore recently. As the operating company is new to the region, it wants to study the buying behavior of consumers. You are appointed as a data analyst by the company to collect statistics on the purchasing pattern of consumers, and to present statistical evidence from the data to be collected from sales counters over a period. In particular, the company is interested in finding the set of items (goods) purchased in one transaction by customers.

The company keeps a log of all the transactions made by consumers over a period of time. Each transaction consists of a set of items (goods) purchased by a consumer. (For simplicity, we ignore item quantity, price and other information from the transaction.) Given the transaction log, the company wants to determine the collection of *itemsets* that meet a certain *support factor threshold*. Each itemset informs the company of the set of items that a consumer frequently buys together.

An itemset X is a subset of a transaction in the transaction log. The support factor of X is the ratio A/B (between 0 and 1) where A is the number of times that X occurs as a subset among all the transactions in the log, and B is the total number of transactions in the log. The company is interested in those itemsets whose support factor is greater than or equal to a certain threshold.

For practical purpose, we assume that the total number of items sold by the company is no more than 100, and that the maximum number of items that can be purchased in a single transaction is limited to 10.

Input

The input file consists of lines of transactions followed by lines of support factor thresholds. Each line of transaction represents the set of items purchased by a customer in a single transaction. The format is as follows:

$< Item - 1 >, < Item - 2 >, \ldots, < Item - n >$

Each item (which is of no more than 10 characters) in a transaction is separated by a comma, except the last one. The items in a transaction are ordered lexicographically. It is further assumed that no item will repeat itself in a single transaction.

The different support factor thresholds follow the transactions after an empty line. Each threshold is a value between 0 and 1.

Output

For each support factor threshold given in the input file, your program should produce the itemsets whose support factor is greater than or equal to the threshold. The format is as follows: For each threshold, the first outline line displays the threshold value. Subsequent lines display itemsets (exceeding the threshold) in increasing order of their size in the following format: Each line begins with a (increasing) count value followed by a dot (`.`) symbol, an itemset, a dash (`-`) symbol, then the support factor (in brackets) of the itemset at two precision values. Note that items in the itemset are comma-separated and must be lexicographically ordered when displayed. When itemsets are of the same size, they must be lexicographically ordered when displayed.

If there is no itemset for a support factor threshold, your program should display only the heading followed by a blank line.

Sample Input

```
soap,toothbrush,toothpaste
aabattery,wristwatch
shoe,soap,tie,toothpaste
aabattery,toothbrush,toothpaste

0.25
0.50
```

Sample Output

```
Relationships for support factor 0.25:
1.aabattery,toothbrush-(0.25)
2.aabattery,toothpaste-(0.25)
3.aabattery,wristwatch-(0.25)
4.shoe,soap-(0.25)
5.shoe,tie-(0.25)
6.shoe,toothpaste-(0.25)
7.soap,tie-(0.25)
8.soap,toothbrush-(0.25)
9.soap,toothpaste-(0.50)
10.tie,toothpaste-(0.25)
11.toothbrush,toothpaste-(0.50)
12.aabattery,toothbrush,toothpaste-(0.25)
13.shoe,soap,tie-(0.25)
14.shoe,soap,toothpaste-(0.25)
15.shoe,tie,toothpaste-(0.25)
16.soap,tie,toothpaste-(0.25)
17.soap,toothbrush,toothpaste-(0.25)
18.shoe,soap,tie,toothpaste-(0.25)

Relationship for support factor 0.50:
1.soap,toothpaste-(0.50)
2.toothbrush,toothpaste-(0.50)
```