

7459 Decode Alien Message

SETI (Search for Extra Terrestrial Intelligence) finally received messages from planet Kepler 452b ! Humans are not alone in the universe! The messages from Kepler 452b are several streams of codes. Through years of decoding efforts, scientists found that the purpose of streams is to explain the secrets of universe and instruct humans to create wormholes for inter-terrestrial travel.

The message said that the universe is a n -dimension timed event system. A stream of codes represents a one-dimension timed event flow. An example of one-dimension timed event flow is in Fig. 1.

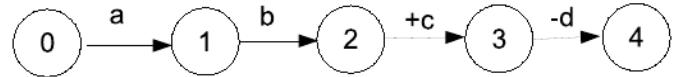


Figure 1: An example of timed event flow.

States are indexed by integers (i.e., circles in the figure), which are the states of spacetime continuum. One symbol from $\{\mathbf{a}, \dots, \mathbf{z}, +\mathbf{a}, \dots, +\mathbf{z}, -\mathbf{a}, \dots, -\mathbf{z}\}$ represents an event that causes the timed event flow to change to next state. The scientist found that an event symbol can be polarized as positive and negative. The functions of polarized event symbols will be explained later.

A one-dimension timed event flow M_i is a tuple $(Q_i, s_i, \Sigma_i, \delta_i, e_i)$, where

- Q_i is a set of states, which is indexed by 0 – 999,
- s_i is the initial state. $index(s) = 0$.
- Σ_i is a set of events, which is a symbol from $\{\mathbf{a}, \dots, \mathbf{z}, +\mathbf{a}, \dots, +\mathbf{z}, -\mathbf{a}, \dots, -\mathbf{z}\}$
- $\delta_i \subseteq Q_i \times \Sigma_i \times Q_i$ is a set of state transitions in which $(q, w, q') \in \delta_i$ indicates that a state $q \in Q_i$ can change into $q' \in Q_i$ with an event symbol $w \in \Sigma_i$.
- The last state of a one-dimension timed event flow is called a final state e .
- Each state $q \in Q_i - \{e\}$, q has exactly only one transition to next state q' and $index(q) + 1 = index(q')$

The universe is n -dimension. Scientists found that a universe model must be composed from n one-dimension timed event flows. The composition is called *quantum-superposition*. That is, the Kepler aliens decomposed a universe model into n one-dimension timed event flows and sent these timed event flows to earth.

A brilliant scientist eventually solved the puzzle and discovered an algorithm to construct a universe model from n one-dimension timed event flows. A universe model U_n can be composed from n one-dimension timed event flow M_i , $i = 1 \dots n$ is a tuple $(Q_1 \times Q_2 \times \dots \times Q_n, (s_1, s_2, \dots, s_n), \Sigma - \{+\mathbf{a}, \dots, +\mathbf{z}, -\mathbf{a}, \dots, -\mathbf{z}\} \cup (\mathbf{a}), \dots, (\mathbf{z}), \Delta, (e_0, e_1, \dots, e_n))$. Δ is the state transition function of U_n which can be computed by the following algorithm:

1. let (q_1, q_2, \dots, q_n) be (s_1, s_2, \dots, s_n)
2. repeat until no more states can be generated.
 - 2.1 for each (q_i, w, q'_i) in M_i and $w \in \{\mathbf{a}, \dots, \mathbf{z}\}$, add $((q_1, \dots, q_i, \dots, q_n), w, (q_1, \dots, q'_i, \dots, q_n))$ to Δ .
 - 2.2 for each $(q_i, +\alpha, q'_i)$ in M_i and $(q_j, -\alpha, q'_j)$ in M_j , $i \neq j$ and $\alpha \in \{\mathbf{a}, \dots, \mathbf{z}\}$, add $((q_1, \dots, q_i, \dots, q_j, \dots, q_n), "+(\alpha)", (q_1, \dots, q'_i, \dots, q'_j, \dots, q_n))$ to Δ .

According to the algorithm, polarized event symbols, $\{a, \dots, z, +a, \dots, +z, -a, \dots, -z\}$, can no longer appear in the universe model U_n . A positive event symbol and a negative event symbol must match in pair (as in step 2.2) to appear as an $(x), x \in \{a, \dots, z\}$ in the universe model.

Fig. 2 is an example of 3 timed event flows. According to the algorithm, a 3-dimension universe model can be constructed as in Fig. 3.

If states are reachable, polarized event symbols, such as $+b$ and $-b$, must match in pair and merge into a “(b)” symbol in the universe model.

After the universe model was constructed, the brilliant scientist found that there are “trapped” universe states, such as $(2, 2, 0)$ in Fig. 3. It is not the final state ($(2, 2, 3)$ is the final state in this example) but no more states can be generated from this state. In physics meaning, Kelper aliens tried to teach humans to manipulate space-time to create black holes in a universe model. These black holes actually serve as wormholes so that future interstellar travel is possible.

Given n timed event flows, please compose the universe model and find the wormholes. There could be more than one wormhole in a universe model.

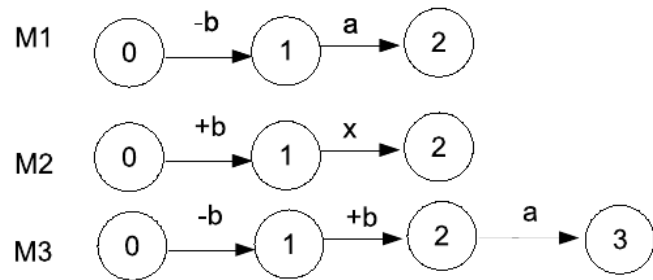


Figure 2: Three timed event flows.

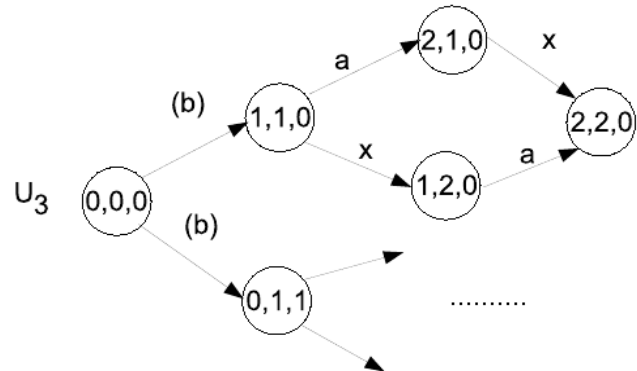


Figure 3: The universe model.

Input

The input file begins with an integer T which is the number of test cases. Each test case begins with an integer n , $2 \leq n \leq 20$ to indicate the number of timed event flows in the test case. Each timed event flow begins with an integer k , $1 \leq k \leq 999$ which is the length of the timed event flow. The length of a timed event flow is the number of transitions. Following the number k is k event symbols from $\{a, \dots, z, +a, \dots, +z, -a, \dots, -z\}$ separated by space. While constructing the universe model, the initial state index starts from 0.

Output

For each wormhole state, please output its state index $(s_0 \ s_1 \ \dots \ s_n)$. These state index is separated by exactly one space. If there are more than one, please output the wormholes in one line in the order that $(a, b, c) \leq (x, y, z)$ if $((a \leq x) \text{ or } (a = x, b \leq y) \text{ or } (a = x, b = y, c \leq z))$ and each wormhole is separated by exactly one space. For example, if there are three wormholes, please output $(1 \ 0 \ 1) \ (2 \ 3 \ 5) \ (7 \ 9 \ 8)$, in which a space is inserted between each wormhole. If no wormhole are found, please output ‘no wormholes’.

Sample Input

```
2
3
2 -b a
2 +b x
3 -b +b c
4
```

```
2 +b +a
2 -a -b
2 +a x
2 -a y
```

Sample Output

```
(2 2 0)
(0 0 2 2)
```