Problem B
Graded Reasoning of Ordinal Conditional Formulas
Input file: pb.txt

Problem Statement

Ordinal conditional functions (OCF) are employed as a kind of knowledge representation formalism in the so-called κ calculus. In the calculus, knowledge is represented as graded implications of the form $(p \to q,\ v)$ where p and q are called events and $v \geqq 0$ is a non-negative integer. The intuitive meaning of the implication $(p \to q,\ v)$ is that $p \to q$ (i.e., p implies q) is believed with certainty 2^{-v}. Given a set of graded implications, other graded implications not explicitly appearing in the set can be derived by a chaining rule. Assume that n events $p_1, p_2, \ldots, p_n$ and a set of implications $S = \{(\ p_i \to p_j,\ v_{ij}) \mid\ i \neq j\ \}$ are given, then an implication $(p \to q,\ v)$ is derivable from S, denoted by $S\alpha\ (p \to q,\ v)$, if one of the following conditions holds:

- (i) $p=q$ (i.e, p and q are the same event) and $v=0$;
- (ii) $(p \to q,\ v) \in S$;
- (iii) for some $v' \leqq v$: $S\alpha\ (p \to q,\ v')$;
- (iv) for some event r and non-negative integers v_1 and v_2:
  $S\alpha\ (p \to r,\ v_1)$, $S\alpha\ (r \to q,\ v_2)$, and $v_1 + v_2 = v$.

The implication degree, $D_S(p,\ q)$, between two events p and q with respect to the set of graded implications S is defined as the smallest integer v such that $(p \to q,\ v)$ is derivable from S. Mathematically, this is defined as

$$D_S(p,\ q) =_{\text{def}} \min \{v \mid S\alpha\ (p \to q,\ v)\},$$

where if $\{v \mid S\alpha\ (p \to q,\ v)\}$ is an empty set, then $D_S(p,\ q)$ is defined as ∞.

Therefore, our problem is to compute $D_S(p_l,\ p_m)$ from the number of events n, the set of graded implications S, and two events p_l and p_m.

Input File Format

The first line of input file consists of a single number denoting the number of test cases in the file. There is a single line containing a '/' character separating two consecutive test cases. The end of the file is marked with a line containing a '.' character. For each of the test cases, the first line contains a positive integer n ($n \le 20$) denoting the number of events and the second line contains a pair of positive integers l and m, separated by a blank space. After the second line, there are several lines that form the set of graded implications S. Each line of S contains a triplet i, j, and v, each separated by a blank space, corresponding to $(\ p_i \to p_j,\ v)$, where $1 \leqq i \neq j \leqq n$ and v is a non-negative integer.

Output Format

For each test case of the input, compute the value $D_S(p_l, p_m)$ and output it in a line. If $D_S(p_l, p_m)= \infty$, then output a special character * .

Sample input:

```
3
3
1 2
1 2 5
1 2 4
1 3 2
3 2 4
/
3
2 3
1 2 5
1 2 4
1 3 2
3 2 4
/
4
1 2
1 3 1
1 2 8
1 4 5
2 3 10
3 2 7
4 2 1
3 4 0
.
```

Sample output:

```
4
*
2
```

Analysis of Case 1

$S\alpha \quad (p_1 \rightarrow p_2, 5)$ since $(p_1 \rightarrow p_2, 5) \in S$;

$S\alpha \quad (p_1 \rightarrow p_2, 4)$ since $(p_1 \rightarrow p_2, 4) \in S$;

$S\alpha \quad (p_1 \rightarrow p_2, 6)$ since $S\alpha \quad (p_1 \rightarrow p_3, 2)$ and $S\alpha \quad (p_3 \rightarrow p_2, 4)$;

So the minimal value is 4