3346 Perfect Domination on Trees

The concept of domination in graph theory arises naturally from the facility location problem in operations research. Consider a geographical area that is partitioned into regions. Facilities are going to be placed in some of the regions. The problem is to cho ose a minimum number of regions at which to place these service facilities, so that each region is served by a facility in it or at least one facility adjacent to it when there is no facility in this region. This location problem can be mo deled by a graph problem to find a minimum-cardinality vertex subset of an input graph such that every vertex not in the subset is adjacent to at least one vertex in the subset. Depending on different requirements in various location problems, domination has many variants. Here we consider one of the variants.

A *perfect dominating set* of a graph $G = (V, E)$ is a subset $D \subseteq V$ such that every vertex v in $V - D$ (that is, $v \in V$ and $v \notin D$) is adjacent to exactly one vertex in D. The *perfect domination problem* is to find a *minimum-cardinality perfect dominating set* D of G, i.e., $|D|$ is smallest among the cardinalities of all perfect dominating sets of G. The *perfect domination number* of a graph G, denoted by $perfect(G)$, is the cardinality of a minimum-cardinality perfect dominating set of G. In this problem, you need to write a program to find the perfect domination number of an input graph which is a tree.

For example, consider a 6-vertex tree T shown in Figure 1. In (a), vertices 3 and 5 do not form a perfect dominating set of T, because vertex 6 is not in $D = \{3, 5\}$ and it is not adjacent to any vertex in D. Furthermore, vertices 4 is adjacent to both vertex 3 and 5. In (b), vertices 3 and 4 form a perfect dominating set. It is also easy to check that 3, 4 is a minimum-cardinality perfect dominating set of T. Therefore, the perfect domination number of this example equals 2.

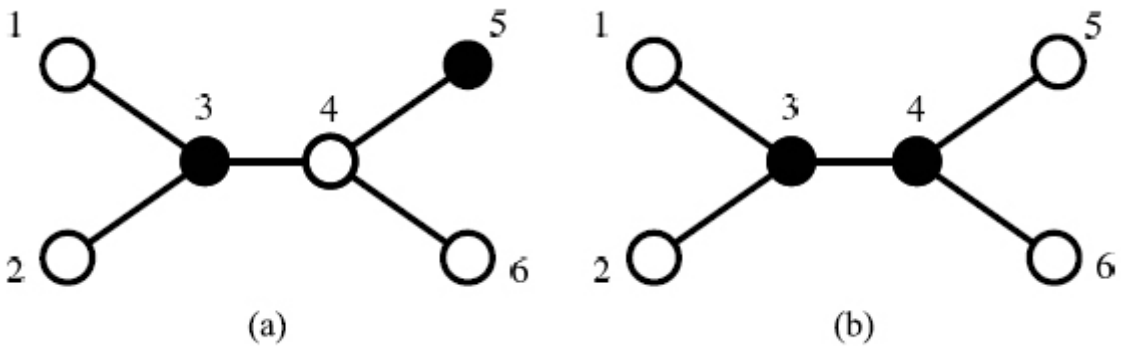

Figure 1: An illustration of a none perfect dominating set and a perfect dominating set

In this problem, the input graph is a tree T with n vertices $\{1, 2, \ldots, n\}$, where $1 \leq n \leq 1000$. Write a program to compute the perfect domination number of T.

Input

The input consists of a number of test cases. Each test case consists of one tree, which has the following format: The first line contains one positive integer $m = n - 1$, which is the number of edges of the tree. The next m lines contain m edges such that one line contains one edge. Each edge is represented by two positive integers; the first integer represents one end-vertex of the edge and the second one represents the other end-vertex. Finally, a '0' at the last line indicates the end of the input file.

Output

The output contains one line for each test case. Each line contains an integer, which is the perfect domination number of the corresponding input tree.

Sample Input

```
5
1 3
2 3
3 4
4 5
4 6
1
1 2
0
```

Sample Output

```
2
1
```