Problem 1.1. (0.25 pt) Consider the following modification of a single-tape Turing machine: The machine cannot decide whether its head moves right, left, or does not move. Instead, if the step number is of the form i^2 (i.e., it is a square of a natural number), the head moves to the very beginning of the tape, and otherwise (i.e., when the step number is not a square of a natural number), the head moves right by one cell.

Prove that such machines can recognize the same languages as original Turing machines.

Problem 1.2. (0.25 pt) Consider the following decision problem:
input: a tree T with edges labeled by natural numbers (lengths), and a number k given in unary;
question: does there exist a simple path between two nodes of T of length precisely k?
Prove that this problem is in **L**.

As a tree we understand an undirected connected graph without cycles. A simple path is a path without loops (i.e., where no node appears more than once). The length of a path is defined as the sum of lengths of edges appearing on that path. You can assume that trees are represented on input in the following way: First we are given a number n, the number of nodes, which are numbered from 1 to n. Then we are given $n-1$ pairs of numbers; for the i-th pair (a_i, d_i) it should hold that $1 \leq a_i \leq i$, and such a pair means that there is an edge of length d_i between nodes number a_i and $i+1$. All numbers in the representation of a tree are given in binary.

(*) Additional problem (0.1 pt) Solve Problem 1.2 when the number k is given in binary.