

# 2019 Canadian Computing Olympiad

## Day 1, Problem 3

### Winter Driving

**Time Limit: 1 second**

#### Problem Description

In the Great White North, there are  $N$  cities numbered from 1 to  $N$ . There are  $A_i$  citizens living in city  $i$ . There are  $N - 1$  roads numbered from 2 to  $N$ . Road  $j$  connects city  $j$  and city  $P_j$ , where  $P_j < j$ . There are at most 36 roads connected to any city.

During winter, all roads will be converted into one-way highways due to dangerous driving conditions. That is, road  $j$  will become a highway that is either one-way from city  $j$  to city  $P_j$  or one-way from city  $P_j$  to city  $j$ .

Every citizen wants to send a holiday card to every other citizen. Citizen  $x$  can send a card to citizen  $y$  if it is possible to travel from the city  $x$  lives in to the city  $y$  lives in using only highways.

What is the maximum number of holiday cards that can be sent after converting all roads to highways?

#### Input Specification

The first line contains one integer  $N$  ( $2 \leq N \leq 200\,000$ ).

The second line contains  $N$  integers  $A_1, \dots, A_N$  ( $1 \leq A_i \leq 10\,000$ ).

The third line contains  $N - 1$  integers  $P_2, \dots, P_N$  ( $1 \leq P_j \leq j$ ).

Let  $D$  be the maximum number of roads connected to any city. It is guaranteed that  $D \leq 36$ .

For 5 of the 25 available marks,  $N \leq 10$ .

For an additional 5 of 25 available marks,  $N \leq 1\,000$  and  $D \leq 10$ .

For an additional 5 of 25 available marks,  $D \leq 18$ .

For an additional 5 of 25 available marks, there will be 37 cities, where one city is connected to 36 other cities, and these other 36 cities are only connected to this one city.

#### Output Specification

Print one line with one integer, the maximum number of cards that can be sent after converting all roads to highways.

#### Sample Input

4

3 3 4 1

1 2 1

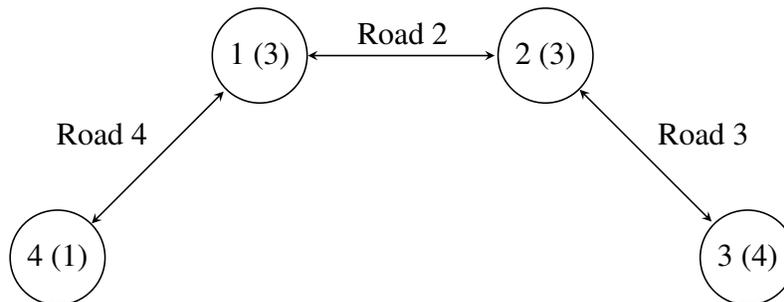
### Output for Sample Input

67

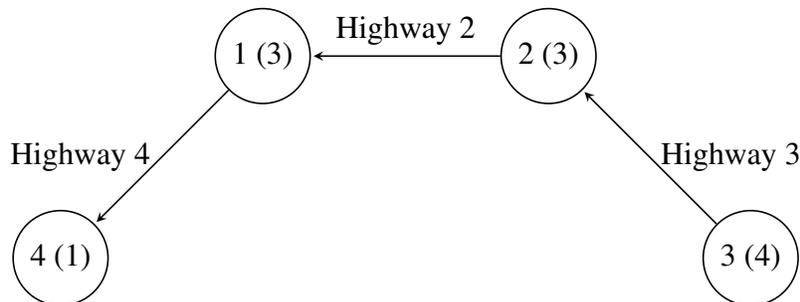
### Explanation of Output for Sample Input

One possible way of converting roads to highways is for road 2 to become one-way from city 2 to city 1, road 3 to become one-way from city 3 to city 2, and road 4 to become one-way from city 1 to city 4.

Consider the following pictures, with the cities and associated population (in parentheses) for the initial roads



and what it looks like after all roads are converted to highways:



Every citizen in city 3 can send 3 holiday cards to city 3 citizens, 3 holiday cards to city 2 citizens, 3 holiday cards to city 1 citizens, and 1 holiday card to the city 4 citizen, for a total of 40 holiday cards sent out of city 3.

Similarly,

- city 2 citizens send 6 holiday cards each, for a total of 18 holiday cards.
- city 1 citizens send 3 holiday cards each, for a total of 9 holiday cards.
- the city 4 citizen cannot send any holiday cards.

A total of  $40 + 18 + 9 = 67$  holiday cards are sent.