Shustrik and Boxes

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	256 megabytes

Shustrik the hamster has a set of n numbered boxes. These boxes can be nested within each other, forming a kind of hierarchy. Box number 1 is the outermost (the root of the hierarchy). For each other box, it is precisely known which parent box it is inside.

Inside each box (along with all the boxes nested within it) are «rods» (edges). Each rod connects two «points» (vertices). All points are numbered. The contents of each box u can be represented as a graph G_u, which is obtained by collecting all edges from box u and from all boxes inside it.

For each box u, Shustrik wants to compute the value of $F(G_u)$.

$F(G) = \sum_{|A|=k} f(A)$, where $F(G)$ is a function of the graph, equal to the sum of functions f from all possible sets of vertices A of size k ($\sum$ is the summation sign). $f(A)$ is a function of a set of vertices, its value is equal to the product of a_i (where a_i is the weight at vertex i) for all $i \in A$, if all vertices in A are pairwise reachable from each other†, and 0 otherwise.

The number k takes only integer values from 1 to 4 ($k = 1, 2, 3, 4$).

For example, for $k = 3$, it is necessary to calculate the sum of products a_i over all connected triples of vertices in the graph.

Help Shustrik tackle this problem and calculate the value of $F(G_u)$ for all boxes.

† Two vertices of a graph are considered reachable if there is a path connecting them.

Input

The first line of input contains one integer k ($1 \le k \le 4$) — the size of the sets for which $F(G_u)$ needs to be calculated.

The second line of input contains two integers n and $m (n, m \le 500000)$ — the number of boxes and the number of vertices in the graph under consideration.

The next line contains $n - 1$ integers — for all boxes from 2 to n, information about which box this box is nested in $p_i < i$.

The following n lines describe the boxes.

First, the number e is given — the number of edges in this box.

Then follow e pairs of numbers describing the edges u, v ($1 \le u, v \le m$).

In the last line, m integers a_i ($0 \le a_i \le 10^7$) are given — the values assigned to the vertices of the graph.

It is guaranteed that the sum of values e across all boxes does not exceed 500000.

Output

In one line, output the value of the function $F(u)$ for all u in ascending order of box numbers. Since this number can be very large, output it modulo 2^{32}.

Scoring

Group	Points	Additional Constraints	Required Groups
1	5	$k = 1,\ n, m \leq 1000, \sum e \leq 2000$	–
2	4	$k = 1,\ n, m \leq 500000, \sum e \leq 500000$	1
3	10	$k = 2,\ n, m \leq 1000, \sum e \leq 2000$	–
4	17	$k = 2,\ n, m \leq 500000, \sum e \leq 500000$	3
5	10	$k = 3,\ n, m \leq 1000, \sum e \leq 2000$	–
6	17	$k = 3,\ n, m \leq 500000, \sum e \leq 500000$	5
7	10	$k = 4,\ n, m \leq 1000, \sum e \leq 2000$	–
8	27	$k = 4,\ n, m \leq 500000, \sum e \leq 500000$	7

Examples

standard input	standard output
2 6 6 1 1 3 2 2 2 5 1 3 5 0 1 2 6 2 4 3 5 1 1 1 4 0 1 2 3 4 5 6	71 4 29 17 4 0
1 1 3 3 3 2 3 1 1 3 2 3 1	6
3 4 4 1 1 3 2 2 3 3 2 0 1 3 2 1 4 2 5 3 6 7	126 0 126 0
4 6 6 1 2 1 1 2 1 4 3 1 3 2 3 3 1 4 3 2 3 0 0 1 2 4 9421632 35415 3345712 8926302 3397495 1390523	2825910272 2825910272 2825910272 0 0 0

Note

Consider the first example.

A hierarchy of boxes is given, where box 1 is the outer box, and each box $u > 1$ is nested in box p_u. For each box, a set of edges between the vertices of the graph is specified.

For $k = 2$, the value of the function $F(G_u)$ is equal to the sum of the products of the weights of all pairs of vertices that belong to the same connected component of the graph G_u. The graph G_u is obtained by combining all edges contained in box u and in all boxes nested within it.

Box 6. In box 6 and in all boxes nested within it, there are no edges, so all vertices are isolated and there are no connected pairs.

$$F(G_6) = 0.$$

Box 5. The graph contains one edge $(1, 4)$ connecting vertices 1 and 4. The only connected pair contributes

$$1 \cdot 4 = 4.$$

Thus,

$$F(G_5) = 4.$$

Box 4. The graph contains edges $(4, 3)$ and $(5, 1)$. Connected components:

$$\{3, 4\}, \quad \{1, 5\}.$$

The total contribution is

$$3 \cdot 4 + 1 \cdot 5 = 12 + 5 = 17,$$

from which it follows that

$$F(G_4) = 17.$$

Box 2. Box 2 has no edges of its own, but it includes edges from nested box 5, namely $(1, 4)$. The only connected pair contributes

$$1 \cdot 4 = 4,$$

therefore,

$$F(G_2) = 4.$$

Box 3. The graph contains edges $(2, 6)$, $(4, 3)$, and $(5, 1)$. Connected components:

$$\{2, 6\}, \quad \{3, 4\}, \quad \{1, 5\}.$$

The total contribution is

$$2 \cdot 6 + 3 \cdot 4 + 1 \cdot 5 = 12 + 12 + 5 = 29,$$

therefore,

$$F(G_3) = 29.$$

Box 1. The graph contains all edges from all boxes. Connected components:

$$\{1, 3, 4, 5\}, \quad \{2, 6\}.$$

The sum over all connected pairs is

$$(1 \cdot 3 + 1 \cdot 4 + 1 \cdot 5 + 3 \cdot 4 + 3 \cdot 5 + 4 \cdot 5) + (2 \cdot 6) = 59 + 12 = 71.$$

Thus,

$$F(G_1) = 71.$$

The final values of the function $F(G_u)$ for boxes $1, \dots, 6$ are:

$$71 \;\; 4 \;\; 29 \;\; 17 \;\; 4 \;\; 0.$$